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Abstracts

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Contents

Current Recommendations for Perioperative Beta-Blocker Therapy

David Bronheim

Class I

1. Beta-blockers should be continued in patients undergoing surgery who are receiving beta-blockers to treat angina, symptomatic arrhythmias, hypertension, or other ACC/AHA class I guideline indications (Level of Evidence: C).
2. Beta-blockers should be given to patients undergoing vascular surgery who are at high cardiac risk owing to the finding of ischemia on preoperative testing (Level of Evidence: B).

Class IIa

1. Beta-blockers are probably recommended for patients undergoing vascular surgery in whom preoperative assessment identifies CHD. (Level of Evidence: B)
2. Beta-blockers are probably recommended for patients in whom preoperative assessment for vascular surgery identifies high cardiac risk, as defined by the presence of more than 1 clinical risk factor. (Level of Evidence: B)
3. Beta-blockers are probably recommended for patients in whom preoperative assessment identifies CHD or high cardiac risk, as defined by the presence of more than 1 clinical risk factor, who are undergoing intermediate-risk or vascular surgery. (Level of Evidence: B)

Class IIb

1. The usefulness of beta-blockers is uncertain for patients who are undergoing either intermediate-risk procedures or vascular surgery, in whom preoperative assessment identifies a single clinical risk factor. (Level of Evidence: C)
2. The usefulness of beta-blockers is uncertain in patients undergoing vascular surgery with no clinical risk factors who are not currently taking beta-blockers. (Level of Evidence: B)

Class III

1. Beta-blockers should not be given to patients undergoing surgery who have absolute contraindications to beta blockade. (Level of Evidence: C)

Since the publication of ACC/AHA Focused Update on Perioperative Beta-Blocker Therapy, the Poise trial has called into question the use and efficacy of beta-blockade. Furthermore, concerns over how, when and how long beta-blockers should be given remain unclear. In this update we will review the current recommendations as well as highlight the current areas of debate in the perioperative use of beta-blockers.

Glycemic Control

Hermann Mellinghoff

Diabetes mellitus is a common medical condition affecting ca. 5% of the population in Western countries. The management of those patients undergoing surgery is particularly challenging, since it has to account for their individual metabolic condition and the organ manifestations those patients have. Among those, arterial hypertension, coronary heart disease, and diabetic renal disease are the most important organ manifestations. In addition to those manifestations of the disease, the type of the diabetes (insulin dependent or non-insulin dependent), the individual pre-operative metabolic condition, including, how well the diabetes has been controlled preoperatively, influence the perioperative management. Finally, the insulin requirements of diabetic patients may vary considerably in the perioperative phase.

The main purpose of the preoperative assessment of a diabetic patient is to gain information on the above mentioned factors that influence the perioperative management. Another cornerstone of that assessment is an exact laboratory assessment: e.g., measurement of glycosylated hemoglobin (HbA1c), and blood sugar levels.

The principal goal of perioperative therapy of the diabetic patient is to avoid a pronounced catabolic metabolism as well as a metabolic decompensation. Pre-operative blood sugar levels should be in the range of 120 - 180 mg/dl. Significantly higher levels of blood sugar may lead to glucosuria and fluid loss while also being associated with those patients being more prone for infectious complications and prolonged wound healing. On the other hand, too low levels of blood sugar increase the risk of hypoglycemia, a condition that may escape the attention of an anesthesiologist during general anesthesia.

Not every patient needs insulin perioperatively. But for those who need it, it is important to give enough insulin to avoid catabolic metabolism. Due to its very small allergic potential, human insulin should be preferred. Numerous algorithms have been described for the application of insulin perioperatively. On a general basis, the anesthesiologist has to take care of the fact, that the subcutaneous application of insulin may lead to greatly varying levels of blood sugar, while its onset of action is approx. 30 minutes and its peak effect is 2-4 hours. As a rule of thumb, 1IE insulin lowers the blood sugar level by 27mg/dl. The intravenous application of insulin allows a better adjustable treatment, while hypoglycemia or hyperglycemia are among the more serious side effects. Also, the intravenous application of bolus doses of insulin is not the physiologic norm, and therefore should not be given preference. In addition, patients with liver disease, obesity, sepsis, those under treatment with corticoids, as well as those undergoing renal transplantation or open heart surgery will require greater doses of insulin. Apart from that, the anesthesiologist must also give the amount of glucose needed perioperatively. This amounts to 1,2-2,4 mg/kg/min for adults and up to 5mg/kg/min for children.

Last but not least, acute complications of diabetes have to be taken care of, namely hyperglycemia, diabetic ketoacidosis and hyperosmolar coma. Diabetic ketoacidosis is usually associated with significant loss of intravascular fluid, i.e., up to 100 ml/kg body weight. The hyperosmolar coma is characterized by high levels of blood sugar (500-600 mg/dl) as well as intravascular dehydration. In both instances, control of blood sugar as well as intravascular rehydration is mandatory and should begin immediately after diagnosis.

Improving Outcomes in Surgical Patients: Temperature Management

Ian Sampson

Evolution of Current Thought

– In the mid-20th century, most intraoperative temperature management was dominated by the demonstrated neuroprotective and cardioprotective effects of hypothermia in potentially hypoxic situations.
– By the 1970's, publications appeared on the negative effects of hypothermia resulting from general anesthesia in operating room temperatures. This led to national recommendations on operating room temperature and humidity (AIA,HVAC, APIC,NFPA).
– During the last quarter of the century, much was published about the effects of even mild postoperative hypothermia and this, although often controversial, produced the SCIP initiative of 2003-2005, designed to achieve postoperative normothermia.

Definition of Terms

– Core Temperature: That of the torso and head.
– Normothermia: 36.5-37.5 degrees centigrade
– Awake interthreshold range: 0.2-0.4 degrees centigrade
– Anesthetised interthreshold range: 2-4 degrees centigrade
– Hypothermia: Under 36.0 degrees centigrade
– Desirable operating room temperature : 20-23 degrees centigrade (68-73 degrees fahrenheit)

Causes of unintentional hypothermia.

– Anesthetic induced redistribution of heat from core to periphery.
– Continuing loss by radiation and convection.

Deleterious effect of hypothermia.

Surgical site infections (SCIP INF 7), myocardial ischemia, cardiac dysrhythmias, increased peripheral vascular resistance, coagulopathy, increased transfusion requirements, left shift in oxyhemoglobin dissociation curve, delayed wound healing, negative nitrogen balance, reduced drug metabolism, delayed emergence, prolonged PACU and hospital stay, postoperative patient cold discomfort

Prevention and Treatment of hypothermia

– Active prewarming
– Intraoperative forced air warming.
– Intravenous fluid warming.

Controversies

The future and SCIP compliance.

Prevention of Deep Vein Thrombosis in the Perioperative Period

Mark Abel

Deep vein thrombosis (DVT) and pulmonary embolism (PE) are now recognized as significant causes of morbidity and mortality in the perioperative period. Intrinsic patient specific risk factors and surgical risk factors contribute to an incidence of DVT and PE as high as 60% and 5% respectively in certain orthopedic populations not receiving DVT prophylaxis. High risk surgical procedures include hip fracture surgery, hip or knee arthroplasty, major abdominal surgery and major gynecologic surgery. Intrinsic patient factors include but are not limited to major trauma, immobility, oral contraceptive use, cancer, advancing age, smoking, inflammatory bowel disease and many others. These factors are loosely combined to define four risk groups: low, moderate, high risk, highest risk. Recommendations for perioperative DVT prophylaxis vary according to the risk group a particular patient falls into.

Thromboprophylactic measures include mechanical and pharmacologic methods.

Mechanical methods stimulate emptying of the calf veins and muscle pumping under anesthesia. Pneumatic compression devices or graded compression stockings are both available modalities. They are primarily used as adjuncts to pharmacologic therapy or when anticoagulation is contraindicated.

Pharmacologic methods include vitamin K antagonists such as warfarin, heparin and low molecular weight heparin derivatives and fondaparinux, an inhibitor of factor Xa. Heparin and low molecular weight heparin (LMWH) administered subcutaneously effectively reduce the incidence of thromboembolism in high and medium risk patients and generally do not result in hemorrhagic complications postoperatively. Heparin must be administered subcutaneously 2-3x/day, whereas LWMH may be given only 1-2x/day. Preliminary studies in major orthopedic and abdominal surgery indicate that fondaparinux is safe and effective.

Although traditional practice with unfractionated heparin involved starting prophylaxis two hours prior to surgery, this practice often resulted in increased bleeding complications. New agents are currently under investigation.

The SCIP Initiative: Antibiotic Administration

David L. Reich

It has been widely reported that patients receive only about half the preventive care that they require (1,2). An issue of emerging importance in perioperative preventive care is the timeliness of administration of antibiotics for prophylaxis against surgical site infection (SSI), a complication that increases length-of-stay, cost of care, and mortality (3). Guidelines issued by the Centers for Disease Control and other groups for prevention of SSI call for the administration of preoperative antibiotics within 60 minutes prior to surgical incision (4,5). However, sub-optimal compliance with guidelines was demonstrated in a US national multicenter data review of data from 2001. In that study, dosing within the recommended 60-minute pre-surgical incision period occurred in 54% of cases.

Surgical antibiotic prophylaxis is a standard of care. The Surgical Care Improvement Project (SCIP) mandate to publicly report surgical antibiotic selection/timeliness and pay-for-performance initiatives by payers are compelling reasons for anesthesiologists to improve antibiotic administration compliance (6). Accrediting organizations and competitive forces in the marketplace are further factors that will motivate hospitals to work with anesthesiologists to have the highest possible rates of compliance. Maximizing antibiotic compliance rates has now become an important intrinsic goal for anesthesia providers since SCIP directly targets processes rather than outcomes in its performance measures.

Wax et al recently reported that a visual interactive antibiotic reminder in an anesthesia information management system (AIMS) resulted in higher rates of timely prophylactic antibiotic administration (7), and O'Reilly et al had similar findings using an AIMS-generated feedback system (8). Another group used a computer-generated reminder to enhance rates of re-dosing of antibiotics (9).

Wax et al found that the increase in compliance with antibiotic administration guidelines was sustained over a 10-month period. O'Reilly et al reported an increase from 70% to 92% compliance with antibiotic timing guidelines over a one year period as a result of several interventions to improve compliance (8). One of the interventions was a reminder item in a case-based "script" in their AIMS, and others were educa-

tional programs and electronic mail performance reporting.
In addition to the contemporaneous reminders, data from the AIMS are extracted and analyzed to generate periodic report cards. These are sent by electronic mail to all practitioners to present their personal performance related to this standard in comparison with the group as a whole, thereby encouraging the staff to improve their performance.

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The Surgical Care Improvement Project (SCIP): Truth or Consequences?

Maria F. Galati

Physician and hospital providers are being challenged to participate in performance measurement programs that put reimbursement (and reputation) at risk in a wide array of programs required by both private and public health plans (1).
In 2005, The Centers for Medicare and Medicaid Services (CMS) were mandated by Congress under the Deficit Reduction Act to plan for the introduction of pay for performance (P4P) into the Medicare program. In the same year, CMS sponsored a consortium of US health quality organizations (including the ASA, ACS, AHA and the JCAHO)* that worked together to develop the Surgical Care Improvement Program (SCIP.) The Program's goal is to improve surgical care by reducing preventable surgical morbidity and mortality by 25% by the year 2010 (2).
SCIP measures, focusing on prevention strategies in four categories of complications (infection, venous thrombosis, cardiac and respiratory) were adopted for reporting under CMS and private organizations such as the JCAHO effective in 2006. Individual SCIP measures have been phased into CMS reporting mandates since 2006 and are tied to hospital eligibility for annual payment rate updates under the Medicare program.
The SCIP infection measure #1 tracking antibiotic prophylaxis prior to surgical incision was already in use by hospitals under a preexisting CMS program (3). It was rolled out as a measure that anesthesiologists were also eligible to report on in a pay for reporting program for physicians that went into effect in 2007.
CMS has also announced a new preventable adverse event reporting mechanism that reverses their practice of paying more to hospitals to care for the treatment of adverse conditions. In 2009, CMS will withhold additional reimbursements to hospitals whose patients suffer serious "never events" such as air embolism, blood-type incompatibility or objects left in patients during surgery, and other adverse events including surgical site and catheter-related infections, hospital injuries and pressure ulcers (4).
Performance measurement has grown rapidly in prevalence and scope moving from voluntary to mandatory programs and spreading from hospital reporting to physician reporting initiatives in both the public and private health care sectors. However, studies to determine the efficacy and cost-benefit of these programs have lagged behind their growth in popularity. Evidence linking P4P to improved quality of care is slight, yet providers are challenged to follow these practices or suffer the consequences (5,6).
All providers must successfully meet the challenge of performance measurement in order to achieve full reimbursement from private and public sector payers

and to secure their reputation for quality care as they come under increasing scrutiny with the public reporting of these performance data.

*ASA= The American Society of Anesthesiologists; ACS= The American College of Surgeons; AHA= The American Hospital Association; JCAHO= The Joint Commission on the Accreditation of Healthcare Organizations.

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ACC/AHA Guidelines for the Perioperative Cardiac Assessment of the Non-Cardiac Surgical Patient

Joseph W. Szokol

The American College of Cardiology and the American Heart Association have jointly published guidelines on issues of cardiovascular disease since 1980. The third iteration of the guidelines dealing with the perioperative cardiovascular evaluation and care of patients presenting for noncardiac surgery was published online in the October 2007 issues of the *Journal of the American College of Cardiology and the journal Circulation* (1). The overriding theme of the document is not simply to lower the risk of surgery but rather asks whether an intervention is necessary regardless of the preoperative context. The purpose of the preoperative evaluation is not to give "medical clearance" but rather an evaluation of the patient's current medical status and to make recommendations regarding the potential for cardiac risk throughout the perioperative period. Finally, no test should be performed unless it is likely to influence the perioperative care of the patient.

The Guidelines are divided into several recommendations: a Class I recommendation is a treatment or procedure that should be performed; a Class IIa is a treatment or procedure that is reasonable to perform; a Class IIb is a treatment or procedure that might be considered; and a Class III is a treatment or procedure that is not recommended. The Guidelines deal with recommendations as to the following subjects: preoperative noninvasive evaluation of LV function; preoperative resting 12-lead ECG; noninvasive stress testing before noncardiac surgery; preoperative coronary revascularization; beta-blocker therapy; statin therapy; preoperative ICU monitoring; use of volatile anesthetic agents; prophylactic nitroglycerin; use of TEE; maintenance of normothermia; glucose control; use of pulmonary artery catheters; intraoperative and postoperative ST-segment monitoring; and surveillance for perioperative myocardial infarction.

There are a few active cardiac conditions where the patient should be evaluated and treated before noncardiac surgery. These are: unstable coronary syndromes; decompensated CHF; significant arrhythmias (high-grade AV block, Mobitz II AV block, symptomatic ventricular arrhythmias, SVT with heart rate > 100, symptomatic bradycardia) and newly recognized ventricular tachycardia; severe valvular disease (aortic valve area less than 1.0 cm^2, mean gradient > 40 mm Hg or symptomatic) or symptomatic mitral stenosis.

In deciding on taking a patient to surgery the Revised Cardiac Risk Index should be considered. The indices are a history of ischemic heart disease, history of heart failure, history of cerebrovascular disease, diabetes mellitus, and renal insufficiency. The Guidelines provide a stepwise approach in dealing with patients based on the nature of the surgery, the patient's cardiac risk index, and the patient's overall functional capacity. The Guidelines also provide guidance to patients with coronary stents and patients without coronary stents but who may need such in anticipation of surgery.

1. www.americanheart.org

Preoperative Predictors of Perioperative Morbidity

Tuula Kurki

There are many predictors of perioperative morbidity. They can be preoperative risk factors related to patient´s pre-existing medical disease or advanced age. They can be intraoperative related to emergency status, site and duration/type of the surgery, hemodynamic stability, type of anesthesia and monitoring, and experience of anesthesiologist/surgeon/team members. They can also be postoperative: anemia, pain relief, availability of postoperative care facility. Major morbidity is related to cardiac events, infections (pneumonia, wound infections), bleeding, thrombosis, stroke or renal failure.

Patient risk factors are defined as the patient characteristics present before entry into the operating room that may place the patient at a disadvantage for a favorable outcome. These factors include severity of cardiac and pulmonary disease, diabetes, cerebrovascular disease, renal dysfunction and other comorbidity factors, general health status, demographics and socioeconomic factors.

There are several risk stratification methods available for the **preoperative risk prediction**. The most frequently used risk models include ASA and NYHA classification. Lee index is used for cardiac patients undergoing noncardiac surgery. The Society of Thoracic Surgeons risk model (STS) , Northern New England Cardiovascular Disease Study Group model (NNE), The Cleveland Clinic Preoperative Model and EUROscore are the most common models used for risk prediction of cardiac surgical patients. There are also risk models for DES patients and for patients scheduled for thoracic surgery. The risk models are valuable tools for the assessment of the postoperative morbidity especially for patient groups.

It is also important to **modify** the existing preoperative risks. Based on preoperative evaluation the patients with cardiac risks are scheduled for cardiac assessment (exercise stress test, dipyridamole thallium test, angiography). Beta blocker and statin therapy can be started for reduction of perioperative risk of cardiac events. If the patient has left main coronary artery stenosis or severe 3 vessel disease, CABG is recommended. If patient has DES, dual antiplatelet therapy shall be continued for 12 months and asperin should not be discontinued at all. Elective surgery shall be postponed for 12 months. Diabetic patients shall have their glucose balance optimized before surgery and all the infection focuses (also teeth) shall be treated. Smokers shall be advised for cessation of smoking 2 months before surgery. Some patients with COPD need pulmonary rehabilitation and corticosteroid therapy. Patients who are alcohol abuse shall be advised to quit drinking. Two months alcohol free will almost normalize the liver function tests.

Prediction of **intraoperative morbidity** is more difficult preoperatively. It is important to modify the patient related risk factors. Experience of surgeon/anesthesiologist team members has to be considered in challenging high risk cases. In emergency cases there is usually not enough time to stabilize the patient condition or modify the risks.

Prediction and modification of postoperative morbidity is also challenging. It is important to develop high-dependency care facilities, quality of postoperative care unit (PACU) teams/guidelines and training of personnel at the surgical wards to better diagnose/treat the postoperative morbid events. Use of pulse oximeters for hypoxemia and telemetry for ischemia detection at the wards is important. Acute pain service shall follow-up the pain therapy postoperatively. Based on the preoperative patient risk factor data the surgical team has to make decisions/modifications for the surgical treatment plans/strategies to optimally treat the patient with reasonable costs and LOS by increasing the QOL and satisfaction of the patients and their family members.

Coronary Artery Disease – Cardiologists Update

Allen H. Unger

The key initiating process in atherogenesis is the retention of APO B lipoproteins, especially the LDL particle. Local biological response to these particles promotes subsequent lesion development and progression. The role of inflammation has been emphasized but the inflammation is a consequence of APO B lipoprotein retention. The most effective therapy to date is LDL lowering drugs, mainly statin therapy. Ongoing improvements include more aggressive lowering of LDL and at an earlier stage in at risk individuals.

Statin therapy has been shown to decrease the inflammatory cells of the atherosclerotic lesion as well as the lipid rich necrotic core which is highly thrombogenic and whose thickness has been implicated in plaque rupture. An increase in carotid intima-media thickness (CIMT) represents an early phase of the atherosclerotic process. Aggressive treatment with statins has halted the progress of CIMT as demonstrated in the METEOR and ACADIM studies. Heated controversy has recently emerged because of the results of the ENHANCE study which demonstrated no difference in changes in CIMT between Vytorin (a combination of a statin, Zocor, and Zetia, a cholesterol absorbtion inhibitor) and Zocor alone despite greater LDL lowering with Vytorin. The AHA and ACC have advised using the highest dose of a statin that is tolerated to achieve goal before adding other medication.

In several large scale trials, statins have reduced CHD mortality and morbidity, the protective effect mirrored the magnitude of LDL lowering. The PROVE-IT and TNT studies provide strong verification that "lower is better" when using statin therapy. How low should we go? The result is not definitely known, perhaps an LDL less than 70 if maintained throughout the entire lifetime or 40 in patients with established CAD. In the PROVE-IT study, patients treated with 80mg of atorvastatin who responded with LDL levels in the 20 – 40mg/dl range had the lowest incidence of cardiovascular events with no increase in drug related side effects.

Members of hunter-gatherer societies who typically have LDL levels <40mg/dl do not develop coronary heart disease even when they reach older age. Thus, evidence mandates continuing and more aggressive use of statins and likely intervention at an earlier stage in the development of the atherosclerotic lesion.

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Perioperative Dental Considerations

Jeffrey Yasny

Perioperative dental damage is one of the most common anesthesia-related adverse events and is responsible for the greatest number of successful malpractice claims against anesthesiologists. Although anesthesia professionals consistently work in the mouth of patients, they may not have received a comprehensively relevant education of dental nomenclature, anatomy and pertinent prostheses. The aim of this presentation is to augment one's awareness of intra-oral conditions and the related perioperative risk factors, which may ultimately minimize the incidence of such dental injuries.

During the preoperative assessment of the patient's dental status, the recognition of vulnerable teeth and soft tissues are of paramount importance in the prevention of perioperative dental trauma. In particular instances, implementing a more "hands-on" evaluation may be valuable. Exercising cautionary measures during provocative events such as laryngoscopy and extubation can also aid in the reduction of dental damage. Special considerations are necessary for the pediatric and adolescent patient populations.

Clear documentation of the patient's preoperative dental condition and notifying the patient of the potential for dental damage will diminish costs for any related post-operative dental treatment. In the event of such an incident, several management tactics can promote a swift and reasonable resolution. Exercising an effective risk reduction strategy for these unfortunate injuries may diminish the incidence of dental damage and financial costs to a medical facility, as well as maximizing anesthetic outcome and patient satisfaction.

Update in Interventional Cardiology: 2007

Samin K. Sharma

The percutaneous coronary intervention (PCI) has come a long way since its introduction in 1977 by Andreas R. Gruentzig, with resultant angiographic success rate of >95% and major complications (death, MI or urgent CABG) of <1.0% at major centers. It is ex-

pected that one quarter of a total approximately one million PCIs in USA will be performed on ambulatory basis with predictable safe out-of-the-hospital 30-day outcomes. First time since its introduction, PCI numbers declined in 2007 as a major impact of the COURAGE trial.

This unprecedented success of PCI was possible on the heels of continuous evolution of newer interventional devices (miniature balloons, hydrophilic and unicore guidewires, thin struts flexible stents, distal protection devices and atheroablative devices), the procedural techniques (high pressure inflation, IVUS guidance, full lesion coverage), short infusion of periprocedural IV antithrombotic therapy (Bivalirudin or bolus of GP IIb/IIIa inhibitor) and long-term dual antiplatelet therapy of Aspirin and Clopidogrel (for minimum 1-year, but longer in some cases).

The introduction of drug-eluting stents (DES) in 2002-2003 was the latest step in providing excellent long-term event-free survival of >90% in majority of patients, but in this last year the issue of very late stent thrombosis (after 1-year) occurring in <1% of cases has recently attracted a significant deal of media and public attention. A Swiss study (SCAAR) concluded that late stent thrombosis is twice as likely to occur in patients who receive DES as in those who get BMS. Although late stent thrombosis is rare, it happens without warning a year or more after the device is implanted and the results are often disastrous. The careful analysis of the possible mechanism has pointed delayed endothelialization of DES and routine practice of only 1-year of dual antiplatelet therapy as the key factor responsible for very late stent thrombosis.

The newer second and third generation DES (Endeavor, Xience V, stent capturing endothelial progenitor cells, bioabsorbable polymer or biodegradable stents platform) have shown great promise in eliminating this issue of very late stent thrombosis, together with a 3-year regimen of Plavix + ASA, which is triple the recommendation of the Food & Drug Administration and the American College of Cardiology. Another Plavix-like drug, Prasugrel (Lilly Company) has shown promise in reducing MACE and stent thrombosis versus Plavix in three randomized trials and is waiting FDA approval.

Another controversy in the field of interventional cardiology was raised by the COURAGE trial, conducted at 50 U.S. and Canadian centers. The assumption was that in patients with stable coronary artery disease, it remains unclear whether an initial management strategy of PCI with intensive pharmacologic therapy and lifestyle intervention (optimal medical therapy) is superior to optimal medical therapy alone in reducing the risk of cardiovascular events and the results showed that, as an initial management strategy in patients with stable coronary artery disease, PCI did not reduce the risk of death, myocardial infarction, or other major cardiovascular events when added to optimal medical therapy. Although the trial has limitations (the preponderance of male patients, the lack of ethnic diversity and *especially*, the use of bare-metal stents) for which it has been criticized, it still raised the question of appropriateness of PCI as initial treatment in patients with *stable* coronary artery disease. The results of COURAGE trial were perceived as the generalization of PCIs, with 15% reduction in the PCI number in 2007.

Another frontier in the field of interventional cardiology has been successful outcome of chronic total occlusions, bifurcation lesions (including unprotected left main bifurcation) and thrombotic lesions. Numerous devices have been introduced and are being developed to increase the procedural success and decrease the complications of these angiographic lesion subsets. Recent, FDA approval of another left ventricular assist device (Impella device) which is simple to use and requires less steep learning curve, has opened the field of LV assist devices in high-risk PCIs with severe LV dysfunctions (LVEF <30%). Availability of two percutaneous aortic valves outside the USA (Edwards-Sapien valve and CORE valve) in high surgical risk (Euroscore mortality of >20%) is another step in expanding the horizon of interventional cardiology and able to help very sick, in need of AS patients with no surgical options.

Ultrasound-Guided Regional Anesthesia Workshop

Meg A. Rosenblatt, Andrew Rosenberg, Christina L. Jeng

Objectives

This ultrasound workshop is offered to anesthesiologists with or without prior experience in ultrasound-guided peripheral nerve blocks. There will be a short didactic session including an overview of ultrasound physics, ultrasound anatomy, indications and principles of nerve blockade and various ultrasound images of upper and lower extremity blocks. The hands-on session will include live models, simulator models, as well as phantom-target stations. Attendees will have the opportunity to practice visualization of nerves and surrounding structures on the live and simulator models and needle visualization and advancement on phantoms.

At the conclusion of this workshop, participants will be able to:

– list the indications and contraindications for peripheral nerve blocks
– discuss the limitations of landmark-based approach to the performance of such blocks
– understand the basic concepts of ultrasound and describe the ultrasound anatomy for upper and lower extremity peripheral nerves
– understand the utility of ultrasound in the performance of peripheral nerve blocks

Basic Ultrasound Principles:

– US transducer = transmitter and receiver
– Electric field across piezoelectric crystals along transducer à US beam
– Beam penetrating body structures
  - reflected
  - refracted
  - attenuated
– Best image when beam perpendicular to target
– Amount of US reflected is proportional to the difference of adjacent tissues to resist the passage of beam (acoustic impedance)
– > the mismatch at the interface of 2 tissues, the more distinct the images are
– US waves transmitted through structures
  - With little reflection (e.g. high water content) → hypoechoic (dark)
  - Structures that block US waves appear hyperechoic (white)
– When probe is *perpendicular* to long axis of nerve, *transverse view* shows round-shaped nerves/vessels
– When probe is *parallel* to long axis, *longitudinal view* shows tubular-shaped nerves

Ultrasound-Guided Regional Anesthesia Workshop-continued

Limitations: US-generated artifacts:

– Attenuation –
  - Progressive loss of energy as waves pass through tissues
  - Decrease in signal intensity as ultrasound travels deeper into tissues
– 2 adjustments can be made
  - Increase gain (increases overall brightness)
  - Increase time gain compensation (control gain independently at different depth intervals) as increase depth of penetration
– Needle visualization –
  - minimize refraction
  - maximize reflection
– ↑ depth of target
  - fewer waves are reflected back to the probe and needle becomes less visible
– Out-of-plane needle approach preferred for deeper targets
– High frequency (8-12 MHz) probes
  - Excellent resolution of superficial structures
– Low (4-7 MHz) frequency probes
  - Deep tissue penetration
– Trade-off between axial resolution and depth of penetration

Safe and successful ultrasound-guided blocks:

– Imaging and detection of target nerve and surrounding structures
– Ability to track needle advancement
– Visualization of local anesthetic spread around nerves
– Allows real-time imaging of nerves, needle, and surrounding structures
– Assures needle proximity to nerve
– Avoids vascular puncture
  - Color doppler to visualize blood flow
– Improves speed of block placement

Lower Extremity Blocks

Popliteal Block:
– Block of sciatic nerve prior to division into:
  - Tibial n.
  - Common peroneal n.
– Sensory below knee
  - Except for saphenous n. distribution

Ultrasound-Guided Regional Anesthesia Workshop-continued

Femoral Nerve Block:
– Lumbar plexus gives rise to:
  - Femoral n.
  - Lateral femoral cutaneous n.
  - Obturator n.
– Sensory/motor to upper thigh
  - Femoral n. becomes saphenous n. below knee
– For: knee arthroscopy, patellar procedures, muscle biopsies, vein ligations, postoperative pain control for ACL

Upper Extremity Blocks

Interscalene Block:
– Block of cervical nerve roots C3-C7
  - C8, T1 40% of time
– For all shoulder and upper humerus procedures

Supraclavicular Block:
– Block at the level of divisions
  - Packed closely
  - Prior to branching
– Excellent for surgeries
  - Below lower 1/3 of humerus
  - Elbow
  - Tourniquet tolerance
– Historically high risk of pneumothorax
– Safely performed with ultrasound guidance

Infraclavicular Block:
– Block of the brachial plexus at the level of the cords
– For surgeries of the forearm, wrist, hand offers consistent block of:
  - Axillary nerve
  - Musculocutaneous nerve
– Can be performed with arm in any position
– Stable positioning and sterility of catheters

Axillary Block:
– Requires multiple injections
– Still may miss musculocutaneous nerve

Ultrasound-Guided Regional Anesthesia Workshop-continued

Resources:
www.nysora.com
www.usra.ca

Recommended Reading:
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Status of Point-of-Care Coagulation Testing

Linda Shore-Lesserson

Monitoring anticoagulation status in the operating room - Point of care testing

POC devices are now available which allow the practitioner to monitor hemostasis at "the bedside" rather than sending specimens to a central laboratory facility. These instruments rapidly assess coagulation and platelet function to aid in providing appropriate targeted therapy. As a result there is a reduction in blood loss and transfusion, fewer complications, and cost reduction.

Heparin Neutralization – The Activated clotting time (ACT) is the most commonly used test to measure heparin anticoagulation. It uses an activator such as celite or kaolin and measures the clotting time by different methods. Normal ACT levels are 80-140s. For CPB, prolongation of the ACT to greater than 400 or 480 seconds is considered adequate, though this is highly debated. For off-pump coronary artery bypass operations (OPCAB), "partial heparinization" is used in some centers in which ACT greater than 300s is targetted. During CPB the sensitivity of the ACT to heparin is altered by hemodilution and hypothermia. As a result ACT measurements do not correlate with heparin concentration or with anti-factor Xa activity. Hepcon HMS® analyzer (Medtronic Inc, Minneapolis, MN) is a device that uses protamine titration assays to determine the blood heparin level. This device can also provide a dose-response curve for an individual patient and indicate how much heparin to administer in order to reach a specific targeted ACT before going onto CPB. In addition it can be utilized for protamine dosing after CPB.

Tests of platelet function:

(Thromboelastograph) TEG

The TEG was first developed by the German Dr. Hellmut Hartert at Medical University of Heidelberg. It measures the viscoelastic properties of blood as it is induced to clot under a low shear environment resembling sluggish venous flow. The patterns of change in shear-elasticity enable the determination of the kinetics of clot formation and clot growth and provide information about clot strength and stability.

The newest group of POC platelet function tests were specifically designed to measure agonist-induced platelet mediated hemostasis. These monitoring systems include The VerifyNow (Accumetrics, San Diego, California), The Clot Signature Analyzer (CSA, Xylum, Scarsdale, New York), The Platelet Function Analyzer, PFA-100 (Dade Behring, Miami, Florida), and PlateletWorks (Helena Laboratories, Beaumont, Texas). The CSA is not currently FDA approved.

Reference:

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Instrument	Mechanism	Clinical Utility
Thromboelastograph®	Viscoelastic clot formation	Post-CPB, liver transplant, drug efficacy
PlateletWorks®	Plt count ratio	Post-CPB, drug therapy
PFA-100®	In vitro bleeding time	vWD, congenital disorder, aspirin therapy, post-CPB
VerifyNow®	Agglutination	Drug therapy
Clot Signature Analyzer®	Shear-induced in vitro	Post-CPB, drug effects
Whole blood aggregometry	Electrical impedance/Many	Post-CPB, drug effects

Heparin-Induced Thrombocytopenia

Norbert Huebner

Heparins are widely used in the perioperative setting.
Heparin-induced thrombocytopenia (HIT) is a serious, antibody mediated complication of heparin therapy.
Approximately 7% - 50% of heparin-treated patients generate heparin-platelet factor 4 (PF4) antibodies.
1% - 5% of heparin treated patients receive a heparin-induced thrombocytopenia with thrombosis (HITT) type II which is a life-threatening complication of the heparin therapy.
HIT type II most often occurs after 5-10 days of exposure to heparin.
Cardiovascular surgery patients are particularily at risk of generating the antibodies and to develop HIT type II.
HIT should be suspected whenever the platelet count decreases by 50%, or when new thrombosis occurs in a patient 5-10 days after the start of heparin therapy.
The recommended treatment for patients with strongly suspected HIT, with or without thrombosis, is the cessation of heparin and initiation of a non-heparin alternative anticoagulant such as direct thrombin inhibitors (lepirudin, bivalirudin, or argatroban), danaparoid or fondaparinux.
The risk of excessive, life-threatening bleeding after cardiac surgery from direct thrombin inhibition should be carefully considered, especially in patients who have had surgery within 24-48 hours.

Activated Factor VII

Kent H. Rehfeldt

Recombinant activated factor VII (rFVIIa) is an approved treatment for bleeding in patients with hemophilia A and B. Recently, there has been considerable interest in the off-label use of rFVIIa to prevent or treat excessive bleeding in non-hemophiliac patients in both surgical and non-surgical settings. Numerous case reports, case series, and at least 17 randomized, controlled trials (RCTs) have been published describing this off-label use.
Normally the circulating concentrations of factor VII and activated factor VII are approximately 10 nmol/L and 0.1 nmol/L respectively (100:1 ratio). Therapeutic levels of rFVIIa are roughly 1,000 times the normal concentration. The half-life of rFVIIa is 2 to 4 hours, although this is deceased in patients who are actively bleeding. Two proposed mechanisms explain the procoagulant effect of rFVIIa: 1) rFVIIa combines with exposed tissue factor (TF) at the site of injured vascular endothelium. The rFVIIa-TF complex then activates factor X and factor IX. 2) In the "TF-independent" pathway, supra-physiologic levels of rFVIIa interact with activated platelets to activate factor X.
A meta-analysis of 17 RCTs analyzed the efficacy of rFVIIa in both surgical and non-surgical settings (1). More than half the included studies showed no benefit in patients receiving rFVIIa and the authors concluded that the available evidence was "unclear" and that the use of rFVIIA "can not be recommended." Conversely, von Heyman et al performed a meta-analysis of case series and found that the use of rFVIIa during major surgery led to decrease in bleeding in 73% of cases (2). Other authors have pointed out that pooled data suggest that surgical bleeding decreases in about 75% of both treated patients and controls (1). A recent Canadian Consensus Conference examined the available evidence regarding the use of rFVIIa in cardiac surgical patients (3). This group also concluded that the benefits of rFVIIa are "unclear." The Consensus Conference went on to say that the routine or prophylactic use of rFVIIa in cardiac surgery cannot be recommended; however the use of rFVIIa as "rescue" therapy in patients with excessive bleeding may be beneficial, although this latter recommendation is based on "weak" evidence (case reports, case series).
When giving rFVIIa to bleeding surgical patients, dosages higher than 50 mcg/kg are generally recommended (often 70 – 90 mcg/kg). If no effect is evident, a subsequent dose should be given within 30 – 60 minutes. Therapy is expensive with an approximate cost of $1 US per mcg.
The majority of published studies have not demonstrated an increased risk of thromboembolism following the off-label use of rFVIIa, although patients at risk for this complication have typically been excluded from RCTs.

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Transfusion Algorithms – Do They Work?

Gregory Nuttall

One of the recommendations of the *Society of Thoracic Surgeons Blood Conservation Guideline Task Force* is that transfusion of hemostatic allogeneic blood products after cardiac surgery should be based upon laboratory parameters that are measured as part of a transfusion algorithm (1). Transfusion algorithms coupled to point-of-care or laboratory-based testing have been studied with cardiac surgery in the operating room. Five out of six prospective randomized trials comparing the use of transfusion algorithms to clinical judgment were very successful in reducing transfusion of blood products (2-7). Two of the studies demonstrated a reduction in bleeding in the ICU and reduced reoperation rate for excessive bleeding with the use of a transfusion algorithm (2,4). The tests used in these transfusion algorithms have included tests of platelet number and/or platelet function and point-of-care activated partial thromboplastin time (APTT) and prothrombin time (PT) monitors. The thromboelastographs (TEG®), PFA-100® have been used as platelet function monitors.

There are two prospective studies of the use of a TEG based transfusion algorithm in liver transplant surgery demonstrating a reduction in allogeneic blood transfusions requirements (8,9).

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Is Old Blood Bad Blood?

Elliott Bennett-Guerrero

Approximately 13.8 million units of allogeneic RBCs are administered in the U.S. annually, with over 2 million units alone going to patients undergoing cardiovascular surgery. Allogeneic RBCs that are stored in modern preservative solutions are approved for use within 42 days after collection. This 42 day shelf life is based largely on the ability of these cells to persist in the circulation for >24 hours. It is well known that RBCs undergo significant biochemical and structural changes during the 42 day period of storage (e.g. decreased RBC deformability, decreased ATP and 2,3-DPG, and a significant increase in abnormally shaped RBCs).

For example we recently published the most comprehensive assessment of stored red blood cells (Bennett-Guerrero et al. PNAS 2007). We analyzed changes occurring during RBC storage focusing on RBC deformability, RBC-dependent vasoregulatory function, and S-nitrosohemoglobin (SNO-Hb). Five hundred ml of blood from each of 15 healthy volunteers was processed into leukofiltered, additive solution 3-exposed RBCs and stored at 1–6°C according to AABB standards. Blood was subjected to 26 assays at 0, 3, 8, 24 and 96 h, and at 1, 2, 3, 4, and 6 weeks. Numerous changes occurred including previously described deterioration in levels of 2,3-DPG and potassium. RBC deformability assayed at a physiological shear stress decreased gradually over the 42-day period. In addition, SNO levels, and their physiological correlate, RBC-dependent vasodilation, become depressed soon

after collection, suggesting that even "fresh" blood may have developed adverse biological characteristics. Time courses vary for several storage-induced defects that might account for recent observations linking blood transfusion with adverse outcomes.

There is growing evidence from "association studies" that the administration of allogeneic RBCs of longer storage duration is an independent predictor of mortality in surgical, trauma, and other critically ill patients. For example, Zallen et al. and Purdy et al. demonstrated an association between the administration of "older blood" and mortality in trauma and septic ICU patients, respectively.

Studies in cardiac surgery have yielded inconsistent results.(5-9) For example, Vamvakas et al. studied a cohort of 416 consecutive patients undergoing low risk CABG surgery. From their data they concluded that "After adjustment for the effects of the risk factors for pneumonia and the number of transfused RBCs, an association was observed between the length of storage of transfused RBCs and the development of postoperative pneumonia. This association should be investigated further in future studies of the outcomes of blood transfusion." However, the same investigators subsequently studied a cohort of 268 patients undergoing CABG surgery at the same institution. In their most recent publication they reported that "This study did not corroborate the previously reported association between transfusion of old RBCs and increased morbidity. However, there is surprisingly little research on the clinical outcomes of the transfusions of old RBCs, and this hypothesis should be investigated further." Leal-Noval et al. studied a cohort of 897 low risk patients undergoing cardiac surgery in Spain. From their data they concluded that "Prolonged storage of erythrocytes does not increase morbidity in cardiac surgery. However, storage for longer than 28 days could be a risk factor for the acquisition of nosocomial pneumonia." Van de Watering et al. observed no independent association of storage duration and adverse outcome, although the lack of complete leucokodepletion in these patients makes it unclear how generalizable these results are to a setting with universal prestorage leukodepletion. However, in a large dataset (n > 4,000), DeSimone et al. (Duke University) observed an independent association between increased duration of storage of allogeneic RBCs and mortality after cardiac surgery. More recently an observational study of 6,002 cardiac surgical patients by Koch et al. published in the *New England Journal of Medicine* showed that increased storage duration was an independent predictor of mortality and other adverse outcomes.

No large randomized trial has examined the impact of duration of stored RBCs on organ dysfunction and mortality in high risk patients. In humans there is no Level I evidence to guide clinicians, and most of the existing data come from non-randomized cohort studies (Level 3) described above. Therefore, high risk hospitalized patients routinely receive allogeneic RBCs that have been stored for a prolonged period of time, largely because there is no definitive proof that the duration of storage of RBCs is of clinical relevance.

Perioperative PRBC Transfusion for Patients with CAD

Joseph Meltzer

An extensive body of literature has been accumulating over the past several years regarding the safety and efficacy of transfusion as a therapeutic modality in critically ill patients, both with and without coronary artery disease.

The Transfusion Requirements in Critical Care (TRICC) trial changed the way many physicians in and out of the ICU approach anemic patients and opened the door to many subsequent investigations into RBC transfusion. While these studies do have their limitations, the preponderance of data appears to indicate that transfusions of PRBC in the population of patients with ischemic heart disease is of limited clinical utility and may carry risk that significantly outweigh benefits, if any.

Despite this body of data, physicians still tend to transfuse their patients with CAD at a higher level of hemoglobin than they do their patients without CAD. The goal of this presentation is to briefly present the current thinking regarding the relationship between anemia, CAD and PRBC transfusion.

The following topics will be addressed:
– anemia and CAD
– PRBC transfusion and oxygen transport
– indicators/"triggers" for perioperative transfusion

Ideally, a large randomized prospective trial regarding the impact of transfusion on the perioperative patient

with CAD would guide our decision-making, however in the absence of such a study, we need to make the decision to transfuse or not to transfuse on the basis of the available data and a knowledge of the physiology of anemia and oxygen delivery via RBCs.

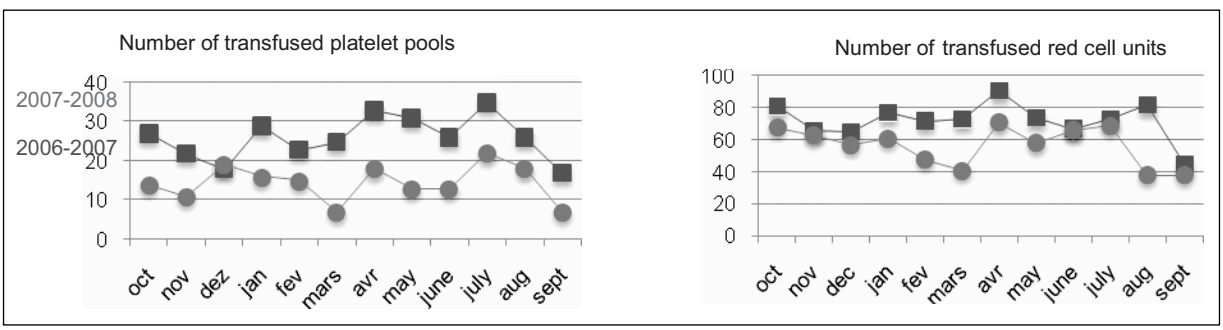
Conclusions from BART – An Attempt to Manage a New Situation in Cardiac Surgery

Anne Risch

Since 1993, when FDA approved the use of Aprotinin to reduce blood loss during coronary-artery bypass grafting, the drug became routinely used in cardiac surgery until 2006. Than, a new chapter of the Aprotinin-Story was observed with controversy and uncertainty: the drug was associated with an increased risk of renal failure, myocardial infarction, stroke and mortality (1, 2). When the results of BART (3) were published in May 2008 the Aprotinin-Story obviously found its final chapter until now: Although Aprotinin was proved to be the most effective hemostatic agent in comparison with the lysine analogues concerning the reduction of bleeding and the need for postsurgical administration of blood products, patients who received Aprotinin in BART had an increased risk of death of more than 50% at 30 days. This result led trial investigators to conclude that Aprotinin should no longer be used in cardiac surgery. Although discussion has surely not found its end, we have to realize the consequences: In our hospital we are working in cardiac surgery since 2001 with no changes in physicians, techniques and no significant differences in the number and kinds of surgeries. However, we recognized a significant increase in administrated postsurgical blood products since Aprotinin was not longer used and completely substituted by tranexamic acid (October 2007).

Obviously forced to accept the evolution in antifibrinolytic agents we were looking to find ways to improve the situation. Since the portion of patients undergoing coronary-artery surgery under antiplatelet treatment (Acetylsalicylic acid (ASA) or ASA and Clopidogrel (Cl)) is 44% in our country, we asked if the routinely use of a Thrombelastograph (TEG® 500, Haemoscop) could be helpful to reduce transfusion?

From April - October 2008 we investigated 87 patients with different antiplatelet treatments (explication see table). Platelet-mapping was performed directly before surgery. For each patient platelets were prepared and directly available. Transfusion of platelets was given after antagonisation of protamine when surgical bleeding was likely to be excluded but further bleeding was observed. Red cells were transfused to keep Hb between 8-9 g/dl. The amount of blood-loss was observed within 24 h after surgery. In patients with ASA treatment we found a good correlation of the effect in platelet-inhibition (r=0,96), bleeding (r=0,97) and transfusion (r=0,95). In patients with combined treatment there was no correlation between measured platelet inhibition, bleeding and transfusion. The Thrombelastograph can detect platelet-inhibition and can help to predict its effect of bleeding in patients with ASA-treatment. Patients with platelet-inhibition of more than 50% seem to have higher risk of postsurgical bleeding. In view of the fact that hemodilution after ECC may intensify hypocoagulability additionally it should be discussed if an early platelet transfusion following ECC can help to prevent further bleeding in ASA treated patients. However, in our patients with combined treatment of ASA and Clopidogrel we found the thrombelastograph not to be helpful to predict the risk of bleeding.



Groups	Number of patients	% inhibition (mean values)	ml blood loss (mean value)	Number of transfused red cell units	Number of transfused platelet pools
ASA until surgery	20	77	662	36	20
ASA stopped 2-5 days before survery	27	58	588	30	19
ASA stopped 6-10 days before surgery	10	28	283	11	4
ASA + Cl until surgery	12	ASA73 Cl 89	720	36	18
ASA + Cl stopped 2-5 days before surgery	13	ASA54 Cl44	510	38	23
ASA + Cl stopped 6-10 days before surgery	5	ASA21 Cl29	664	5	8

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The Role of Serine Protease and their Inhibitors in Modern Medicine

Dave Royston

Serine proteases are the principal control protease found in the plasma. They have actions in the coagulation, immune and inflammatory processes. This presentation will concentrate on the role of serine protease in the coagulation and haemostatic process.

Two compounds that are involved in the initiation of clot formation that are clinically available are recombinant activated Factor VIIa and human thrombin. The former is used intravenously and the latter is used topically to enhance haemostasis and reduce bleeding associated with major surgery.

The bigger interest from the pharmaceutical companies is in the development of inhibitors of the coagulation system using orally active agents. The agents currently available are the vitamin K antagonists that are not without serious side effects as well as requiring continuous monitoring to ensure that the drug is producing an effect in a tight therapeutic window.

The two targets for the newer orally active agents to inhibit coagulation are thrombin and activated factor X (FXa). An example of the former is Dabigatran and Rivaroxiban the latter although all the major pharmaceutical firms have similar compounds in Phase 2/3 development. The clinical development pathway for novel anticoagulants often involves evaluation in short-term use for indications such as prevention of perioperative venous thrombosis and thromboembolism (VTE). Dabigatran has been studied in randomized studies in over 8000 patients having orthopaedic surgery using enoxaparin as the comparator drug. These studies (RE-MODEL,RE-MOBILIZE & RE-NOVATE) showed a similar efficacy and safety (incidence of major bleeding) to the enoxaparin group. The studies with Rivaroxiban (RECORD 1,2&3) showed a significant reduction in the incidence of VTE, from about 3% in pa-

tients allocated to once daily enoxaparin to about 0.5% in those allocated to once daily Rivaroxiban.
The real benefits for clinical practice are not only that these drugs are given orally but also the therapy is started 4-6 hours after the surgery. This is of major significance in relation to the use of neuraxial or other regional techniques that may have been contraindicated when other anticoagulants such as heparin had been administered.
The final compound to discuss is the serine protease inhibitor aprotinin. The first question to address from the title of the presentation is 'does aprotinin have a role in modern medicine?'
Over the past three years a succession of reports has suggested that high-dose aprotinin therapy in patients undergoing heart surgery with cardiopulmonary bypass may be associated with increased morbidity and mortality.
The most recent concerns follow the publication of certain data from the BART study claiming increased mortality in aprotinin treated patients and no significant efficacy benefit over tranexamic acid or epsilon aminocaproic acid. This made certain international regulators to halt marketing of aprotinin. But have regulators acted appropriately? Unlike other instances of drugs that have been pulled for obvious reasons of safety, aprotinin is far from a "slam dunk" case. In fact, the closer one looks at the published data, the weaker the case becomes. These aspects will be discussed.

Hazards of the Anesthesia Workstation

James B. Eisenkraft

In this presentation, I will review:
1. Critical incidents and adverse outcomes associated with use of the anesthesia workstation. This will include the latest figures available from the ASA Closed Claims Project as well as case examples.
2. Strategies to promote safer use of these devices, including education and training, awareness of the 2004 ASA Guidelines for Anesthesia Machine Obsolescence.
3. New pre-use checkout guidelines, a 2007 work product of the ASA Committee on Equipment and Facilities.

Current Status of Evoked Potential Monitoring

Andrew D. Rosenberg

Evoked potential monitoring is utilized to monitor the spinal cord during surgery to identify and hopefully correct any significant changes in spinal cord function that might result in permanent neurologic damage. Spinal cord function monitoring includes somatosensory evoked potential monitoring (SSEP) for monitoring the sensory portion of the spinal cord, EMGs for monitoring nerve roots and neurogenic motor evoked potentials (NMEP), and the newest method – transcranial motor evoked potentials (TCMEP) for monitoring the motor component of the spinal cord.
When performing TCMEPs, stimulating electrodes are placed in the scalp in defined positions over the motor cortex and the stimulus generated results in transmission along the motor portion of the spinal cord. Electrodes placed distally in the upper extremity, in the abductor pollicis brevis muscle, and in the lower extremity, in the tibialis anterior muscle, receive information and transmit it to the computer for analysis. The introduction of TCMEPs was delayed until the safety issue of the repetitive stimulus of the motor cortex could be evaluated. It was feared that repetitive firing of the motor cortex by transcranial stimulation might result in formation of an epileptogenic focus. The characteristic waveforms of TCMEPs are observed during the procedure and changes are treated in the same manner as changes in SSEPs. Patients may have to have their hardware removed, rotation of the spine changed, and distraction released. In addition, blood pressure should be raised to supernormal levels as blood supply may be compromised in watershed areas as a result of distraction or other manipulation of the spine. A wake up test may have to be performed. In order to obtain accurate TCMEPs, the patient cannot have muscle relaxant in effect, and very low if any inhalation agent administered. Some patient's TCMEPs are easily affected by high concentrations of nitrous oxide. Therefore, patients undergoing TCMEP monitoring tend to receive narcotics and a propofol infusion as their main anesthetics. These patients would thus seem to be candidates for awareness monitoring, as there is the potential for awareness as a result of the anesthetic that is necessitated by the monitoring equipment.
While the stimulus that is generated on the scalp travels to the motor cortex for the purpose of evaluating the spinal cord it also causes direct local stimulation of

muscles including the masseter muscle and other muscles of mastication. Since there are no muscle relaxants being used, each time a stimulus is generated there is a strong contraction of these muscles and a significant clenching and biting down of the jaw and teeth. Tongue lacerations, broken teeth and jaws, and biting through endotracheal tubes have been reported in the literature. Since patients are frequently operated in the prone position for spine surgery it is important to make sure that the tongue is not positioned between the teeth and that it is properly protected. Gravity can result in movement of the tongue from a safe position to one between the teeth. A bite block made up of gauze placed around a tongue depressor can be positioned between the molars in order to protect the tongue, teeth and tube. Please check that the endotracheal tube and tongue are safe after positioning the patient.

Pedicle screws are utilized during spine surgery. One method for evaluating motor function during pedicle screws placement is with the use of EMGs. After placement of the screw an electrical current is applied to the pedicle screw and the current needed to generate a motor response from the local nerve root is determined. The higher the current needed to elicit a motor response, the further the screw is from the nerve root and the safer the nerve. When performing EMGs, the patient cannot be paralyzed and therefore muscle relaxants cannot be administered during this part of the procedure and for the appropriate period before the testing so that their effect has dissipated.

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Will Cerebral Oximetry Replace Pulse Oximetry?

Christopher A. Troianos

The American Society of Anesthesiologists' guidelines for anesthesia care recommend use of pulse oximetry in all patients receiving anesthetic care, yet nearly 10% of patients may have a 10 minute continuous gap of measurement or greater intraoperatively (1). A variety of independent predictors of pulse oximetry data failure include ASA physical status 3, 4, or 5 and orthopedic, vascular, and cardiac surgery. Intraoperative hypothermia, hypotension, hypertension, and duration of procedure are also independent risk factors for pulse oximetry data failure (1), while abnormal hemoglobin, medical dyes, and ambient light may affect the accuracy of the measurement.

Cerebral oximetric monitoring with near-infrared spectroscopy targets cerebral microcirculation through cutaneous determination of regional oxygen saturation (rSO_2). Because cerebral tissue (with its limited oxygen reserve) is sensitive to changes in oxygen delivery, rSO_2 monitoring may serve as an "early warning" of decreased oxygen delivery to other major organs. Unlike pulse oximetry, pulsatile flow is not required, so oximetric data may be obtained during periods of low perfusion and cardiopulmonary bypass. Intervention based on the data obtained from rSO_2 monitoring may be used to reverse decreasing cerebral perfusion and avert prolonged ischemia of the brain and other major organs, thereby reducing the incidence of postoperative cognitive dysfunction. An asymmetric or unilateral change in regional oxygen saturation during cardiac surgery generally indicates a mechanical problem causing reduced oxygen delivery to one cerebral hemisphere, while bilateral hemispheric changes prompt therapy that increases systemic vascular resistance, cardiac output, or $PaCO_2$. A greater degree of muscle relaxation or anesthetic depth may also be indicated for increasing rSO_2 by decreasing oxygen consumption. Finally, hemoglobin concentration may need to be increased if rSO_2 values do not improve with manipulation of blood pressure, cardiac index, $PaCO_2$, anesthetic depth, and muscle relaxation.

Recent evidence suggests that maintenance of rSO_2 above 75% results in a lower incidence of major organ morbidity, defined as cerebral vascular accident, renal failure, deep sternal infection, prolonged mechanical ventilation, reoperation, or perioperative death (2). Cerebral oximetry detects changes in oxygenation ear-

lier than standard pulse oximetry during periods of apnea (3). The likely explanation is that cerebral oximetric monitoring evaluates both venous and arterial vascular beds, while pulse oximetry evaluates primarily arterial oxygen saturation (3).

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Update on Depth of Consciousness Monitoring in the High Risk Surgical Patient

Kishor Lathi

Awareness or explicit recall of sensory perception during general anesthesia is a serious adverse event with an estimated incidence of 0.1 to 0.2 % (1). With 21 million patients receiving general anesthesia per year in North America, this translates to about 100 patients per day experiencing this complication. Awareness can be a horrifying experience which has been showcased in the media and in a recent Hollywood movie (Awake!). JCAHO posted a sentinel event alert to highlight the issue and urge hospitals to do more to reduce this complication (2). Subsequently ASA issued a practice advisory addressing this issue (3).

Processed EEG monitors offer the prospect of reducing anesthesia awareness and better titrating the depth of anesthesia. The Bispectral Index (BIS, Aspect Medical Systems), uses a proprietary algorithm, to calculate a single dimensionless number that provides a measure of the patient's level of consciousness. BIS is the global leader in the marketplace and has been used in over 27 million patients. Yet controversy persists as to its reliability and usefulness in reducing the incidence of awareness. As a result, widespread acceptance of brain function monitors (BFMs) has not occurred.

The B-Aware prospective randomized study showed a reduction in awareness among high-risk patients to whom anesthesia was administered with a BIS targeted protocol as compared to a routine care group (4). A Cochrane Meta-analysis supported this conclusion (5). However the recently published B-Unaware trial showed no difference in the incidence of anesthesia awareness when clinicians followed a BIS-guided protocol, as compared to an end tidal inhaled agent concentration (ETAG) targeted protocol (6).

How can we reconcile these apparently conflicting results? Perhaps these results are not contradictory at all. A protocol driven anesthetic management which pays close attention to the depth of anesthesia is a necessary precondition to reduce anesthesia awareness.

Accurately calibrated agent concentration monitors, with low and high limit alarms, are not often used in daily practice. Furthermore, we do not have ability to monitor total intravenous anesthesia concentrations (TIVA). EEG based BFMs measure changes in cortical activity, and thus are a more specific end organ monitor. But the relationship between cortical EEG and consciousness is complex and sometimes unpredictable. Reliance on a single number (BIS, Entropy etc) to assess depth of consciousness is not realistic. Assessing the raw EEG signal, possible artifacts, CNS pathology, and drug induced EEG changes are all part of our analysis of depth of anesthesia.

Opponents of BFMs demand an exacting standard which is not achieved by any of our current monitors including EKG and pulse oximetry. BFMs provide a direct window to cortical activity and can assist us in better assessing depth of consciousness, provided we use the monitors judiciously, understand their limitations, and integrate the information with our clinical judgment and experience.

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Changes in Cardiopulmonary Resuscitation and Why

Peter K. Schoenwald

Modern cardiopulmonary resuscitation (CPR) is a relatively recent event. Electric shock to terminate ventricular fibrillation was first reported by Zoll in 1956, Safer and Elam independently reported on artificial ventilation in 1958 and Kouwenhoven published his experience with closed-chest cardiac massage in 1960. Ventilation and chest compressions were blended into the technique presently known as CPR. Intraoperative demonstrations of its effectiveness by Safer and Kouwenhoven during cardiac arrest led to consensus guidelines for CPR sponsored by the National Academy of Science in 1966. Training was advocated for providers of emergency cardiac care (ECC) and was politically managed by the American Heart Association (AHA) for many years. The International Liaison Committee on Resuscitation (ILCOR) was formed in 1996 and participated in the development of the 2000 Guidelines for CPR and ECC (1). Inherent in those guidelines was international agreement about effective ECC, the chain of survival, the need for early defibrillation, the role of advanced cardiac life support (ACLS), training the public in CPR and advocating public access and availability of automatic external defibrillators (AEDs).

The conduct of CPR and the recommendations for ACLS have changed over the years. This is due to the fact that the recommendations rely on evidence-based medicine and, as studies reveal outcome data, this new science is incorporated into present practice. Advances in technology and data regarding the increased effectiveness of biphasic electrical current in defibrillators have been incorporated. The medical community had made great strides in reaching its 2000 guidelines and recommendations. Yet, despite a massive effort from the international community to improve outcome, incoming data did not realize their expectations. Review of the data was disturbing enough that in 2005, new guidelines were released in an effort to incorporate the new science (2).

Intrinsic in the new guidelines were changes which affected compression and ventilation rates, compression to ventilation ratios, defibrillation recommendations, pharmacologic interventions, training techniques for basic life support (BLS), ACLS and resuscitation team management. Abella et al noted that the quality of chest compressions was frequently only fair to poor and the compression rate was inadequate 50% of the time for in-hospital cardiac arrests (3,4). Aufderheide et al reported that excessive ventilation interferes with effective cardiac output and reduces cerebral perfusion (5). Kern et al suggested improved coronary perfusion when interruptions of chest compressions were minimized (6). Wik et al found increased success in converting ventricular fibrillation in out of hospital cardiac arrests when CPR was performed prior to electrical cardioversion (7). Van Alem et al demonstrated that the best chance for successful cardioversion occurred after the first shock and hence challenged the increasing joule shock sequence (8). Hightower et al demonstrated a rapid decay of the quality of chest compressions over time due to rapid fatigue (9).

These studies influenced the guidelines for 2005 and changed the way the AHA approaches BLS and ACLS training. Reading is required before classroom training because classroom time focuses on hands-on effective CPR technique. The following points are emphasized; 1) good CPR is essential for good outcome, 2) compressions must be hard and fast, 3) interruptions of chest compressions must be minimized, 4) hyperventilation is avoided, 5) early defibrillation favors success, 6) changes in defibrillation/CPR timing, 7) biphasic shock should be utilized and not stacked, 8) changes in algorithms, 9) changes in drug management and 10) emphasis on an organized team approach. These recent changes incorporate new science, but the field is still in flux and evolving. Ongoing work focuses on even less ventilation and more on early conversion from v-fib when the cardiac milieu favors its success. This work may change recommendations for successful and effective CPR yet again (10,11).

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The Patient with a Drug-Eluting Stent Requiring Non-Cardiac Surgery

John G. T. Augoustides

Drug-eluting coronary stents (DES) pharmacologically retard stent endothelialization with sirolimus or paclitaxel. Dual antiplatelet therapy (aspirin and clopidogrel) is recommended for at least 12 months after DES placement. The patient with DES is at significant perioperative risk for stent thrombosis and death. The surgical stress response is prothrombotic. The DES presents a thrombogenic surface, since stent endothelialization is often incomplete. Perioperative DES thrombosis occurs due to a thrombogenic CAS surface, a hypercoagulable perioperative stress response, and inadequate oral platelet blockade.

As per current ACC/AHA guidelines, elective surgery should be deferred until 1 year after DES placement. Patients with DES who require surgery within this recommended time frame should be maintained on dual antiplatelet therapy perioperatively. If the bleeding risk is judged to be excessive and likely catastrophic (e.g., neurosurgery), then clopidogrel should be discontinued at least 3-5 days preoperatively. Based on expert opinion, it is reasonable to admit the patient for intravenous anticoagulation with heparin and a platelet blocker (e.g. tirofiban) until surgery.

The perioperative care of a patient with DES mandates multidisciplinary collaboration (surgeon, anesthesiologist, and cardiologist). Perioperative thrombosis of DES is best managed with prompt percutaneous coronary intervention.

Future coronary stents will be less thrombogenic. Current DES, however, mandate meticulous perioperative planning and prompt intervention if thrombosis occurs.

The Patient with Obstructive Sleep Apnea: An Update

Martin Nitsun

Obstructive sleep apnea (OSA) is recognized as an increasingly prevalent health issue in the United States. Sixty to ninety percent of patients with OSA are obese. Recent data from the CDC indicates that in 2007 the wave of obesity continues to swell. Only one state in the United States had a prevalence of obesity (BMI > 30) less than 20% (1). As the epidemic of obesity grows, the incidence of OSA is certain to continue to increase. Additionally, there is increasing evidence and increasing recognition of the association between OSA and cardiovascular disease (2). Anesthesiologists serve as the final gatekeeper prior to patients undergoing surgical procedures. It is imperative to recognize the signs and symptoms of OSA, to acknowledge the association with cardiovascular disease, to probe our patients health histories and to educate ourselves on how best to manage these patients in the perioperative period.

OSA with its implications for airway management and the potential for cardiovascular compromise can affect patients throughout the perioperative period. A recent study by Chung et al. concluded that 66% of patients with unexpected difficult intubations who consented to undergo post-operative sleep study were diagnosed with OSA (3). Closed-Claim studies regarding airway compromise reveal a significant incidence of adverse airway events occuring in patients with obesity and OSA (4). An expert consensus document published by the American Heart Association/American College of Cardiology recognizes the important association of OSA with cardiovascular disease including hypertension, heart failure, coronary disease, stroke and arrhythmias. This same document however, recognizes " ... need of a substantially expanded knowledge base ..." to further establish links and causality (2).

Recognizing the perioperative implications of OSA, the American Society of Anesthesiologists published practice guidelines for the perioperative management of patients with OSA (5). The guidelines provide assistance for managing patients with OSA throughout the perioperative period. Recognizing that the majority of patients with OSA have no formal diagnosis, the foremost obligation is to identify patients with suspected OSA. Chung et al. screened 2,467 preoperative patients without previously diagnosed OSA using three screening tools, the Berlin Questionnaire, the STOP questionnaire (**S**nore, **T**iredness, **O**bserved apnea, high blood **P**ressure) and the American Society of Anesthesiologists checklist. They found there was no significant difference in the three screening tools. They found all three demonstrated a "moderately high level of sensitivity for OSA screening (6). Therefore, in the absence of a formal polysomnogram (PSG), a presumptive diagnosis can be made using a variety of simple screening tools.

Once a diagnosis of OSA has been established either by PSG or clinically, the ASA guidelines help to guide management throughout the perioperative period. They suggest the use of peripheral nerve blocks or regional anesthesia rather than general anesthesia if possible. All patients undergoing MAC should be monitored with capnography as the use of sedatives and opioids will predispose patients with OSA to airway obstruction. If general anesthesia is necessary, preparations should be in place for managing a difficult airway. Patients with OSA should be extubated fully awake, fully reversed and in the semi-recumbent position. Postoperatively, non-opioid analgesics techniques should be used such as administration of NSAIDs, infiltration of local anesthetics, and placement of peripheral nerve blocks. Disposition, including outpatient vs. inpatient and monitored vs. unmonitored settings, should be determined on a case by case basis, taking into account the severity of OSA, the invasiveness of surgical procedure and the need for postoperative narcotics.

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Organ Donation after Cardiac Death

Marc J. Popovich

The demand for solid organs for transplantation continues to outstrip the supply from living (e.g. kidney, liver) and deceased sources. Because of this growing need, newer donation philosophies have evolved from what has been, for the last half-century, the traditional main source: a patient declared dead by brain-death criteria, but with functioning, usable end-organs as a result of cardiopulmonary sustaining measures.

Over the last several years, jurisdictions and hospitals across the country are permitting the harvesting of organs for transplant use in patients who are declared dead by cardiac, rather than by brain criteria. With organ donation after cardiac death (DCD), the patient is monitored without extraordinary life-supportive measures until there is cardiac standstill; after a predetermined length of time, organs may then be harvested.
The concept of acquiring organs after death by cardiac criteria has many clinical, legal and ethical implications. With more and more hospitals acceding to this form of organ procurement, anesthesia providers used to providing care for organ harvests in the traditional manner and unfamiliar with DCD may suddenly find themselves being asked to participate in this new philosophy of organ retrieval.
This presentation is therefore designed for anesthesiologists to:

– Be familiar with the clinical, legal, and ethical implications of organ procurement
– Recognize the fundamental differences between brain-death vs. cardiac-death criteria
– Appreciate the controversies associated with DCD, and
– Understand how DCD is operationally implemented

Postoperative Delirium

Christopher J. Jankowski

Introduction

The population is aging. The elderly have surgery at a higher rate than younger patients. Postoperative delirium (POD) is among the most common complications after surgery in older patients. It is associated with increased morbidity, mortality, length of hospital stay and likelihood of nursing home placement. Because of this, POD adds substantially to health care costs.

Definition

Delirium is an acute (hours to days) change in mental status characterized by disturbed attention and altered perception of the environment. There can be associated sleep-wake alterations, and cognitive and emotional changes. Delirium tends to fluctuate in intensity over the course of the day. There are two forms of delirium after surgery. Emergence delirium occurs upon emerging from general anesthesia and resolves over

minutes to hours. POD occurs between postoperative days one and three and it generally lasts from hours to days. However, it may persist for months.

Mechanism

Several mechanisms have been proposed for POD, including alterations in neurotransmitter activity, especially in the cholinergic system. Other possible mediators include lymphokines and melatonin. However, the mechanism is likely multifactorial.

Predictors

Preoperative: Age greater than 70 years is a strong predictor of POD. Other patient factors include preexisting cognitive impairment, history of alcohol abuse, depression, preoperative use of opiates, dehydration, visual impairment, and medical comorbidities. Type of operation is also important. Incidence is highest with hip fracture, cardiac and vascular surgery.

Intraoperative: Large blood loss, transfusion, and glucose and electrolyte abnormalities are associated with POD. Type of anesthesia does not appear to influence the incidence of POD.

Postoperative: Pain increases the risk of POD. However, mode of analgesia – parenteral opioids vs. epidural, for example – does not appear to alter its incidence. Postoperative medications associated with POD include meperidine (but not other opiates), anticholinergics and benzodiazepines.

Prevention

When possible, predisposing factors should be mitigated. For example, pain should be treated aggressively and dehydration should be avoided. Normal sleep patterns and ambulation should be encouraged. Patients should be reoriented frequently. Geriatrics consultation to ensure optimal perioperative management reduces the incidence and severity of POD. Finally, prophylactic low dose perioperative haloperidol appears to reduce the length and severity of POD.

Intervention

In addition to being the result of anesthesia and surgery, delirium can be the result of an evolving medical condition. Indeed, in elderly patients delirium is frequently the first sign of a variety of medical conditions. Therefore, the presence of POD should prompt consideration of organic causes and their treatment, if present. Measures to reorient patients to maintain normal sleep patterns are helpful. Haloperidol and atypical antipsychotics are used to treat agitated patients.

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Pediatric Pain Management

Stelian Serban

Perioperative pediatric pain management encompasses different modalities of analgesia. Although the mainstay of treatment remains perioperative opioid and nonsteroidal administration, novel interventional techniques such as thoracic, lumbar, caudal and intrathecal gain more popularity due to their efficacy and lack of (or at least decreased) side-effects and associated decreased hospital stay.

This presentation will succinctly address new intrathecal and epidural opioid techniques for perioperative pain management, such as morphine, local anesthetics, clonidine, etc.

More and more adolescents are newly diagnosed with Crohn's disease; taking care of their perioperative analgesic regimen remains a constant challenge among anesthesiologists and surgeons alike. New modalities of postoperative pain and preemptive analgesia ensue lately for this particular challenging group.

Epidural analgesia with opioids and local anesthetics does not only decrease the pain scores but also attenuates the bowel inflammatory response and hospital length of stay.

Update on the New Obstetric Anesthesia Practice Guidelines

Helene Finegold

Practice Guidelines are not meant to dictate the way one practices medicine but rather to enlighten the practitioner to changes in current thought and help with clinical decisions. It is important to recognize that the guidelines DO NOT represent standard of care. They do not guarantee any specific outcomes.
Over 2986 articles were reviewed in preparation of the new obstetric anesthesia guidelines and these recommendations are mainly evidence based. The ASA House of Delegates approved the new guidelines on October 18, 2006 and they were published in *Anesthesiology* in 2007. This lecture will highlight the changes that are most likely to impact your approach to the pregnant patient and those that represent new ideas compared to the previously published guidelines.

Highlights to be discussed include:

Preanesthetic Evaluation
– History and physical must be performed on all obstetric patients
– Communication with obstetric colleagues encouraged
– Platelet count/type and cross not necessary for routine deliveries

Aspiration Prevention
– Clear liquids for healthy laboring patients up to 2 hours before induction of anesthesia in uncomplicated cases
– Solid food should be avoided in laboring patients

Neuroaxial techniques for labor and delivery
– No need to wait until a predetermined level of cervical dilation to administer regional anesthesia
– Early placement of spinal or epidural catheters for patients with potential anesthetic or obstetrical complications
– Neuroaxial anesthesia should be offered to patients attempting vaginal birth after cesarean delivery
– Regional anesthesia does not increase rate of cesarean section
– Combined spinal epidural anesthesia is safe and effective
– Pencil point needles should be used, cutting needles should not be used

Cesarean Section
– Personnel/equipment should be comparable to OR suite
– Phenylephedrine and ephedrine are both safe and acceptable for use

Emergencies
– Maternal arrest warrants cesarean section in 4 minutes if maternal circulation not restored

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Sepsis: An Update

Corey Scurlock

Despite advances in other aspects of health care sepsis still carries an unacceptably high mortality rate. This is secondary to unfamiliarity with the sepsis syndrome as well as a lack of understanding of the complex pathophysiology. Since 2001 there have been significant advances in critical care that have led to a reduction in mortality and morbidity rates in these patients. These include using a low tidal volume lung protective approach when ventilating the septic patient, use of activated protein C in the severely septic patient and early aggressive fluid resuscitation combined with inotropic therapy. Yet these proven interventions are still not widely practiced.
In other areas there is still considerable controversy on standard treatment patterns for sepsis. This includes the level of metabolic control for which there is conflicting data between medical and surgical patients. Steroids, which until recently thought to be of benefit in septic shock may actually increase mortality. In addition there is new data that use of colloids in fluid resuscitation in the severe sepsis may be harmful particularly when combined with intensive insulinization.

The presentation will contain:
1. A definition of Systemic Inflammatory Response Syndrome (SIRS), Sepsis, Septic Shock and Severe Sepsis.
2. A discussion of early goal directed therapy (EGDT) and ARDSnet ventilation

3. A discussion of recent changes in steroid replacement therapy for septic shock.
4. A particular focus on recent controversies in intensive insulinization and metabolic control.
5. Discussion of recent changes in choice of colloid versus crystalloid in fluid resuscitation in the septic patient.

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Mayhem in the Lung

H. Michael Marsh, Pranav Patel

Acute Lung Injury/Adult Respiratory Distress Syndrome (ALI/ARDS) is estimated to cause death in up to 75,000 patients per year in United States hospitals, with a frequency of 18-79 cases per 100,000 person years in the community (1). ALI/ARDS may be induced by extrapulmonary sepsis or inflammation, or by pulmonary disease, usually a primary pulmonary infection. One recent study (2) of outcome from ALI/ARDS necessitating institution of mechanical ventilatory support showed that after adjusting for measures of severity of illness, using APACHE and SOFA scores, for severity of lung injury, and for ICU management exposure variables, using tidal volume, plateau pressure and fluid balance during the first seven days after diagnosis, the extrapulmonary versus pulmonary source of sepsis underlying ALI/ARDS was not independently predictive of mortality (2).

This suggests a common natural history of the disease, passing through phases of diffuse alveolar damage to repair or fibrosis. However, the exact pathology in each case is not easily ascertained without lung biopsy (3), coupled with immunohistochemistry and electron microscopy. Classical early studies were performed by Bachofen & Weibel (4), defining the steps in extrapulmonary ALI from damage of lung to repair. ALI is characterized by cytokine activation of neutrophils and phagic cells, interstitial pulmonary edema, loss of alveolar type I cells and alveolar flooding during the acute phase. Alveolar type II cell and fibroblast proliferation follow, with repair and reconstitution of alveoli, and/or fibrosis and scarring with alveolar loss, being seen during patchy lung remodeling. The course of ALI/ARDS is also modified by secondary infection and/or mechanical damage, with VAP (ventilator associated pneumonia) and VILI (ventilator induced lung injury) as possible causes. Antibiotic resistant organisms are particularly virulent in this regard and some recent work defines the possible pathways involved (5). As these processes are better defined, new antitoxin vaccines maybe added to newer antibiotics to help control infection. Therapy aimed at calming the inflammatory fires stoked by mechanical damage may also alter outcome.

Prone positioning, first introduced into therapy for ALI/ARDS in 1977 (7), is under reinvestigation in ongoing randomized clinical trials (RCT's). Surfactant instillation, found useful in infantile respiratory distress has not yet been proven in adults. Low dose corticosteroids may have some place in treatment of septic shock but remain problematic in ALI/ARDS, as does the use of other medications aimed at modulating inflammation, coagulation and fibrinolysis. A current approach to evidence-based therapy for ALI/ARDS will be presented, building on this theoretic base.

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Management of Vasoplegic Syndrome after Cardiac Surgery

Hynek Riha

Vasoplegic syndrome after cardiac surgery with cardiopulmonary bypass represents systemic inflammatory response characterized by severe vasodilation. The clinical picture of vasoplegic syndrome includes low systemic vascular resistance (SVR) with significant hypotension, tachycardia, normal or increased cardiac output and low filling pressures with increased requirements for fluids and vasopressors. The incidence of vasoplegic syndrome following surgery with cardiopulmonary bypass is reported in wide range of 8–30%.

Among risk factors for developing vasoplegic syndrome are pre-operative therapy with calcium channel blockers, angiotensin-converting enzyme inhibitors, and intravenous heparin, and amiodarone therapy and severe left ventricle dysfunction in some studies. The pathophysiologic mechanisms involve activation of several vasodilator pathways due to systemic inflammatory response syndrome caused by cardiopulmonary bypass. Responsible compounds include IL-1, NO, ANP, cGMP, bradykinin, impaired vasopressin system, and many other molecules.

Norepinephrine refractory vasoplegia after surgery with cardiopulmonary bypass is a severe complication with high morbidity and mortality. Without appropriate therapy the syndrome advances to the shock state with subsequent multiorgan failure. Besides adequate monitoring and fluid therapy the conventional therapy comprises vasopressor support with phenylephrine, norepinephrine, and vasopressin. In many cases vasoplegia is refractory to relatively high doses of norepinephrine (≥ 1 mcg/kg/min). In these patients vasopressin or its analogs (terlipressin), or methylene blue are used to restore low SVR.

Vasopressin (arginine vasopressin, AVP) stimulates V1 receptors which are found on many cells including vascular smooth muscle cells with resulting vasoconstriction. Exogenous AVP has vasoconstrictive effects within minutes of application. For treatment of vasoplegic syndrome it is typically used in continuous infusion. Terlipressin (triglycyl-8-lysin vasopressin) is used as intravenous bolus (1–2 mg) or continuous infusion. The side effects encompass arteriolar vasoconstriction in splanchnic vascular bed with resulting decrease in hepatic blood flow. The other pharmacologic option is methylene blue which binds to soluble guanylate cyclase. By this way it inhibits increase in the level of cGMP, and thus antagonizes the effects of nitric oxide and other nitrovasodilators. The dose typically given is 1.5–2 mg/kg with 20–30 minutes infusion time, and it could be used before surgery (in patients with high risk of developing vasoplegic syndrome), during surgery, or after surgery as rescue therapy.

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New Antibiotics and Antifugals in the ICU

Silvester Krcmery

Urinary tract infections (UTI) are one of the most common cause of bacteremia in ICU patients. Polymicrobial infections are more common in elderly hospitalized patients and infections with other organisms than E.coli (Proteus spp., Klebsiella spp., Pseudomonas aeruginosa, etc.) are more frequent. Complicated UTI should be considered. For the treatment of acute pyelonephritis, selection of choice are fluoroquinolones, second – or third – generation cephalosporins or carbapenems. Recommended duration of treatment is 7 - 14 days and parenteral to oral switch therapy should be used whenever possible. Abdominal infectious diseases are the leading cause of in-hospital morbidity and mortality. Usual pathogens in normal host with acute cholecystitis or cholangitis are E. coli, Klebsiella, Enterococci and for preferred i.v. empiric therapy meropenem or piperacillin/tazobactam should be used. Most frequent pathogens for intraabdominal peritonitis/abscess comprise Enterobacteriaceae and Bacteroides spp. Empiric i.v. therapy for moderate or severe disease should be initiated preferably with meropenem or piperacillin/tazobactam and for i.v. to oral switch clindamycin plus moxifloxacin is recommended. Linezolid, the first FDA-approved oxazolidi-

none, has demonstrated in previous studies in-vitro and in-vivo activity against resistant gram-positive bacteria, such as staphylococci, streptococci and enterococci, including methicillin and vancomycin resistant strains. In the group of 32 patients hospitalized in six Slovak hospitals for severe and nosocomial infections, therapy with linezolid was successful in 87.5 % of patients. Initially all patients received linezolid 600 mg i.v. every 12 hours with oral switch in 9 patients. Acute osteomyelitis was diagnosed in 8 patients, sepsis associated with indwelling i.v. catheter in 7, nosocomial pneumonia in 6, acute bacterial endocarditis in 4, severe skin and soft tissue infection in 4 and CAPD peritonitis in 3 patients, respectively. Almost total biologic availability of linezolid after oral administration enables to switch from parenteral to oral therapy after clinical improvement. Thus, it can shorten the time of hospitalization and reduce costs of the treatment in ICU patients. Successful antibiotic resistance control strategies include microbial surveillance to detect resistance problems, infection control precautions to limit spread of clonal resistance, restricted hospital formulary and preferential use of low-resistance antibiotics by clinicians.

Inhalational Sedation in the ICU

Joachim Radke

Due to the lack of „everyday equipment“, the use of volatile anaesthetics on the intensive care ward has hitherto only been possible at great cost with the employment of commercially available anaesthetic systems. A new anaesthetic conserving device (AnaConDa®) now facilitates, from a technical viewpoint, the routine use of volatile anaesthetics in intensive care patients as part of prolonged sedation, using ICU ventilators.

The volatile anaesthetics are hereby applied continually via a syringe pump into a miniature vaporizer, which is integrated into the ventilator circuit in place of the usual respiratory filter. During expiration, the anaesthetic exhaled by the patient enters the recirculation system, is mostly collected there in the active carbon filaments and redirected into the inspiratory air. At clinically relevant concentrations, more than 90% of the gas is recirculated in such a way. Aside from the possibility of using a central anaesthetic gas scavenging system, the use of special passive residual gas filters which can be connected to the expiratory outlet of the respirator appears above all to be practical.

The use of volatile anaesthetics on the intensive care unit could in the future adopt a permanent position in various intensive care analgosedation concept. It may be possible thereby to optimise the treatment process both in medical and economical terms. It must be mentioned, however, that current marketing authorisation criteria at this time allow for the prolonged use of volatile anaesthetics only as „off-label use“ at the physician’s discretion.

DNR in the OR: The Ethics of Informed Refusal

James E. Szalados

Clinical Case Scenarios

CASE 1. A 45 year old unconscious male presents to your trauma center in hemorrhagic shock following a motor vehicle accident and multiple life threatening injuries, there is no family present. He is taken directly to your operating room where you begin your anesthesia/resuscitation. You have just started your first unit of packed red cell transfusion (50 cc infused) when the OR phone rings and there is a family member call to say that the patient is a Jehovah’s Witness and that he refuses blood products. How do you proceed?

CASE 2: A 92 year old patient presents for cataract surgery. The patient is DNR (assume that your facility does not routinely suspend DNR in the perioperative period) and refuses general anesthesia. In any case, such cases are routinely performed under a surgeon-placed bulbar block with MAC/conscious sedation at your institution. Shortly after the patient receives the block, he is apneic and in imminent cardiovascular collapse. How do you proceed?

CASE 3: In the maternity suite a baby is born with APGARS 1/3 and a cardiopulmonary resuscitation is initiated. The baby is resuscitated after 29 minutes of aggressive resuscitation. The baby’s parents are not consulted. Are there legal implications?

CASE 4: A 32 year old female presents for hysterectomy – she has signed a refusal to accept blood or blood products before surgery. During surgery, she begins to hemorrhage during a complicated dissection. The sur-

geon tells the family that the bleeding is uncontrollable and that she is 'dying'. The family tells the surgeon and also calls into the room telling you that they are now speaking on behalf of the 'incapacitated' patient and that, as her proxies, they are 'ordering' that you administer blood to keep her alive, or, that they will sue you. What are your considerations? How do you proceed?

Discussion Overview:

Every medical decision has inevitable ethical and legal implications. To a large extent clinicians are taught to recognize the individual variability in patient preferences and to accommodate these wishes into our treatment plans. The respect for individuality and autonomy is a fundamental tenet in American jurisprudence. The respect for autonomy and self-determination have superceded the paternalistic substituted judgment that characterized the early years of medicine. The issues of 'informed consent' and its corollary 'informed refusal' are fundamental to shared medical decision-making and are required by state statutes, federal agencies, accrediting bodies, and hospital policies. The violation of informed consent protocols may result in criminal and/or civil charges, and/or disciplinary action by state licensing agencies.

The basic premise of informed consent is that any intervention must be accompanied by a documented disclosure or explanation of the associated risks, benefits, and alternatives. Nonetheless, disclosure presupposes clear communication including both the delivery and understanding.

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Anesthetic Considerations for Adult Ambulatory Patients

Michael Chietero

One of the major issues in ambulatory anesthesia that continues to be a significant problem for both the patient and the practitioner is still post-operative nausea and vomiting (PONV). It still occurs in 20-30% of patients and can lead to delayed discharge from the PACU, unplanned hospital admissions, significant post-operative discomfort, increased incidence of pulmonary aspiration, as well as disruption of surgical repairs. After pain, it is the most commonly reported symptom.

There are many risk factors for developing PONV, and they can be divided into patient related, anesthesia related and surgical related risk factors. Apfel and Roewer identified four high-risk factors for PONV: female gender, history of motion sickness or previous PONV, use of postoperative opioids and non-smoking status. As the causes of PONV are multifactorial, a multimodal treatment regimen is usually most effective. Pharmacological therapy can be divided into preemptive (preventative) and rescue (treatment after symptoms arise) therapy. Steely and colleagues have recommended a multi-modal PONV prophylaxis regimen. This regimen includes liberal intravenous fluids, gastric suctioning at the completion of surgery and a multiple drug regimen for PONV prophylaxis. A summary of techniques to avoid PONV is outlined below:

– Adequate hydration during the intraoperative and postoperative period.
– Gastric suctioning, especially if blood was swallowed during the procedure.
– Moving patients slowly from the operating room table to the stretcher and also avoiding sudden turns during transport to the PACU.
– Avoiding inhalation anesthetics.
– Use of total intravenous anesthesia (TIVA), with propofol.
– Adequate postoperative pain control.
– Limited use of postoperative opioids.
– Use of pharmacological agents for the prevention and treatment of PONV (dexamethasone, serotonin antagonists such as ondansetron, dopamine antagonists such as metoclopramide and droperidol, as well as the newer neurokinin receptor antagonists such as aprepitant).

Despite the best intraoperative efforts, PONV can still occur in the PACU. Re-dosing of serotonin antagonists, a common practice, has been shown to be no more effective than placebo. Rescue drugs should target a different receptor class than the prophylactic medication.

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Sedation for Adult GI Endoscopy

Lawrence B. Cohen

Sedation improves the quality and success of colonoscopy, enhancing its technical performance as well as patient tolerance and satisfaction. These benefits, however, must be weighed against the added cost and complications associated with the use of sedation and analgesia. Consequently, the practice of sedation varies from country to country, and even within regions of an individual country. In the United States, for example, sedation is used routinely during colonoscopy by more than 98% of endoscopists. The method used most often consists of a benzodiazepine combined with an opioid narcotic. Propofol has gained considerable popularity among endoscopists during the past decade, and is now used during one in three endoscopic examinations nationwide (1). This practice varies considerably from region to region, however, with rates of propofol use ranging from 43% in the mid-Atlantic to 7% in the northeast. The range of sedation practices is still greater within Europe. A recent international study of 21 centers in ten European countries and in Canada reported that the use of sedation during endoscopy ranged from 0% to 100% at different sites (2). The reasons for such diversity are complex, and reflect social, cultural, regulatory and economic considerations.

Current Methods of Sedation

Benzodiazepine/opioid sedation. The majority of patients sedated with midazolam and an opioid are satisfied with their experience, in large measure due to the anterograde amnesia produced by midazolam (3). Some patients do experience discomfort during their procedure, however. Patients with high levels of pre-procedure anxiety, those with a history of alcohol or substance abuse, and those with a history of being difficult-to-sedate are more likely to have an unpleasant experience during colonoscopy performed under midazolam and a narcotic. In such cases, referral to an anesthesia specialist should be considered. A recent summary of pooled results from 11 colonoscopy studies using midazolam and a narcotic determined that 88% and 89% of physicians and patients, respectively, were very satisfied with the results of sedation using a midazolam/narcotic combination (4).

Propofol-mediated sedation. Numerous studies confirm that the use of propofol is associated with improved patient satisfaction, physician satisfaction, and more rapid induction and recovery, compared to traditional sedation agents. Gastroenterologist-directed administration of propofol can be performed safely and effectively. A recent meta-analysis of 12 randomized controlled endoscopy trials comparing the safety of standard sedation using a benzodiazepine plus an opioid versus propofol (both administered under the direction of a gastroenterologist), concluded that propofol was at least as safe as conventional sedation (5). A statement issued jointly by the three major gastroenterology societies as well as a position paper from the AGA Institute support the practice of gastroenterologist-directed propofol administration. Worldwide, more than 400,000 patients have been sedated with gastroenterologist-directed administration of propofol. The safety experience is excellent and an economic analysis indicates that the use of monitored anesthesia care for average risk patients undergoing screening colonoscopy is not cost-effective.

Future Directions

Fospropofol disodium. A prodrug of propofol that is metabolized by alkaline phosphatases, releasing propofol, phosphate and formaldehyde. Clinical trials demonstrate that fospropofol can be titrated safely and reliably to moderate sedation (6). The FDA rejected the application for approval with "moderate sedation" labeling, and at the current time, its future remains uncertain.

Computer-assisted personalized sedation (CAPS). CAPS is currently under development. CAPS incorporates the unique features of target-controlled propofol infusion, patient-controlled supplemental boluses of propofol, and an automated monitoring system that is programmed to reduce or interrupt drug infusion in response to clinical or physiologic indications of oversedation. Phase 2 and 3 clinical studies confirm that CAPS is an effective and safe method of propofol delivery (7). Approval of this delivery system is expected during the first half of 2009.

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Office-based Anesthesia: Suggested Techniques

Douglas Blake

This information about office-based anesthesia (OBA) as practiced at Dudley Street Operatory (DSO) since 1997 is intended to guide anesthesia providers, recognizing that no standard text exists for OBA, and formal training in residency is rare. This is by no means the final or best work on the topic, but rather a summary of what has worked in the past. Improvements are always welcome.

PROPOFOL-KETAMINE (P-K) INFUSION:
Can be regulated to provide light sleep to total intravenous anesthesia (TIVA)
Superior to "intermittent bolus" propofol for cases longer than 30 min.
Mixture: 50 cc propofol/ 50 mg ketamine/ (50 mg lidocaine in first bottle only)
Infusion settings: Wt. in kg; infusion at 50 mcg/kg/min; Bolus at 500 mcg/kg (usually 2-5 cc); rarely exceed basal rate; use bolus for reactivity. Turn off infusion 5-10 min prior to end of case.
Adjuvant drugs: Midazolam 2 mg/ fentanyl 50 mcg initially (consider small supplements; limit narcotics). Ketamine 20-30 mg + P-K bolus from pump prior to injection of local anesthesia or stimulation. Prophylactic anti-emetics (dexamethasone, droperidol, ondansetron) are strongly recommended. At end of longer cases, ephedrine 25 mg I.V. + 25 mg S.Q. is strongly recommended; it avoids vagal episodes and hypotension in PACU, as well as helping with awakening.

OYXGEN SUPPLEMENTATION:
Rarely needed for brief cases; use nasal prongs where possible; run a flow of O2 no greater than necessary to maintain adequate saturation.
Facial plastic surgery: Nasopharyngeal airway (NPA) (#7 for females, #8 for males) into which a 16 FR. Levin tube has been inserted. Connect the Levin tube to an O2 source using a "5-in-1" or "universal adaptor." Nasal surgery: Oro-pharyngeal airway (OPA) (#9 for females, #10 for males) into which a Levin tube has been threaded along the left channel and taped into place; same connection to O2 source. Both airways are lubricated with lidocaine jelly and inserted after induction of anesthesia.

INTERCOSTAL BLOCKS:
Mixture: Lidocaine 1% w. epi 1:100K 50 cc + Bupivicaine 0.25% 50 cc; 3cc/block
Refer to standard texts for recommended technique. Prone position for abdominoplasty; block T12-T6. Supine position for breast surgery; block T3-T10. Dilute remainder of mixture w. 30 cc RL and perform "field block" of incision lines and surgical field.

Anesthetic Considerations for Pediatric Ambulatory Patients

William J. Greeley

This lecture will address current issues in ambulatory pediatric surgery in five areas: 1) procedural selection, 2) patient selection, 3) pre-operative considerations, 4) inter-operative considerations, and 5) post-operative considerations.

Procedural Selection:
Procedural selection criteria include easily controlled physiologic derangements, known low anesthesia and surgical complications, and a short procedure of duration (usually less than four hours). Common pediatric procedures include BMTs, T&A, endoscopic sinus surgery, foreign body, otoplasty, scar revision, hernia repair, cystoscopy, minor orthopedic surgery, tear duct probing and strabismus surgery.

Patient Selection:
Inclusion criteria for ambulatory surgery include healthy ASA, PS1 & PS2 patients, stable PS2 & PS3 patients with cardiac disease, and stable oncologic disease. Patients should not present any probability for admission. Patients with latex allergy or history of drug aphylaxis are not candidates.

Pre-operative Consideration:
Routine labs are not required. Inpatients less than 6 months of age; a hemoglobin is suggested. Pregnancy testing is required. Premedications usually consist of midazolam; alternatively, acetaminophen can be used as well as ketamine. Parental presence requires preparation and flexibility.

Intra-operative Consideration:
Induction is usually performed via mask using sevoflurane and nitrous oxide and oxygen. Desflurane maybe preferred as the maintenance anesthetic for better predication of offset. Consideration is given to propofal based on the history of nausea and vomiting. Intra-operative neuromuscular relaxants with vecuronimum and suxamethonium may be utilized. Usual intra-operative opioids are fentanyl and morphine.

Post-operative Consideration:
Post-operative problems usually consist of pain management and post-operative nausea and vomiting. Risk factors for post-operative vomiting maybe due to

patient factors, e.g., anxiety, anesthesia factors, e.g., volatile anesthetics and opioids or surgical factors, e.g., strabismus surgery. The commonly used ondansetron or dexamethasone or droperidol for antiemetic purpose in children. Discharge criteria include no emesis within 30 minutes, all questions answered, prescriptions reviewed, adequate hydration, legal guardian, and pain score less then five. Unplanned admission maybe due to respiratory distress such as obstructive breathing, O2 saturation. Persistent nausea and vomiting although rare maybe an explanation of an unplanned mission.

Endo Bronchial Ultra Sound or EBUS use in Thoracic Surgery

Paul F. Waters

The EBUS bronchoscopy technique has proven extremely useful for mediastinal evaluation – both for the staging of patients with lung cancer and to attempt diagnosis of lesions adjacent to the major airways, without the use of more invasive techniques.
The instrument is a specially designed fibroptic bronchoscope with a "built in" linear ultrasound probe, with color Doppler. The device comes with the hardware and software support to allow real time interrogation of the mediastinum, visualization of areas of interest and performance of trans-airway needle biopsies where appropriate. Color Doppler, which detects movement, is useful for determining flow, and avoiding damage to major vessels. Immediate cytologic evaluation can be carried out and the lesion, in the case of lung cancer, staged in much the same way that mediastinoscopy has been employed. The procedure is best performed under general anesthesia, and may be done just prior to definitive surgery for the lung lesion if so desired. As more experience is gained, conscious sedation may be appropriate in certain cases.
Detailed description of the technique and experience with it will be presented.

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Antioxidant Therapy in Patients Undergoing Thoracic Surgery

David Amar

Inflammatory and oxidative mechanisms have been linked to acute coronary syndromes, stroke and atrial fibrillation/flutter unrelated to surgery. Aside from perioperative beta-blocker protection, novel therapies are sorely needed to modulate the detrimental effects of inflammation in postoperative patients without suppressing its beneficial actions.
Statins are known to be anti-inflammatory, antioxidant, nitric oxide synthesis enhancing and anti-thrombotic. The 2002 ACC/AHA/NHLBI Clinical Advisory on the Use and Safety of Statins concluded that it might be prudent to withhold statins during hospitalization for major surgery. Emerging observational studies including our own however, showed that statin use prior to surgery conferred a protective role against cardiovascular complications after noncardiac surgery, and acute withdrawal of statin therapy may pose significant cardiovascular risk.
Pulmonary complications after thoracic surgery occur in > 20% of patients and maybe severe enough to lead to ARDS and death. The pathophysiology of post-lung resection pulmonary edema or acute lung injury is uncertain, although the use of blood products, barotrauma related to mechanical ventilation and extent of mediastinal lymphatic resection may be contributory factors.
Ischemia-reperfusion injury may also contribute to lung injury in that operative ischemia may lead to lung damage, but on reperfusion, injury is increased owing to the formation of reactive oxygen species, possibly secondary to neutrophil recruitment and activation in the lung.
This talk will explore use of statins as anti-oxidant and anti-inflammatory agents in patients undergoing thoracic surgery.

Atrial Fibrillation following Cardiac Surgery

Richard C. Daly

Incidence:
Atrial fibrillation (AF) is the most common complication following coronary CABG reported in a range of 5–50% (most between 18 – 25%), depending on risk factors. Post-CABG AF occurs most commonly on the second day postoperatively.

Risk Factors:
Postoperative hemodynamic and volume shifts, ischemic injury, heightened adrenergic tone, atrial manipulation, surgical manipulation, inflammation, ischemia, cardioplegia, electrolyte shifts, and the use of anesthetic and adrenergic drugs are all potential contributors to the development of post-CABG AF. Patient characteristics associated with an increased risk of AF include advanced age (>70 years), male gender, history of AF or supraventricular tachycardia (SVT), hypertension, left ventricular hypertrophy, increased left atrial size, renal insufficiency, obesity, and left ventricular dysfunction or a history of heart failure. Surgical variables associated with an increased risk of post-CABG AF include pulmonary vein venting, bicaval venous cannulation, prolonged cross-clamp times, concomitant valve operations, use of an intraoperative balloon pump, postoperative pneumonia, prolonged ventilation, and postoperative atrial pacing. Other risk factors include non-use of beta blockers preoperatively and abrupt discontinuation of preoperative beta-blockers.

Clinical Significance:
A number of adverse consequences are known to be associated with postop AF including: hemodynamic deterioration, intra-atrial thrombus formation with subsequent stroke or thromboembolism, and, increased length and cost of hospital stay. The most important adverse consequence of post-CABG AF is stroke. Stroke occurs in about 2% of patients undergoing CABG. AF is the cause of about one-third of strokes occurring after on-pump CABG and about one-half of strokes occurring after off-pump CABG. Post-CABG AF prolongs the length of hospital stay and the cost of treatment.

Prophylaxis:
Three separate meta-analyses of randomized controlled trials have clearly demonstrated that beta-blockers reduce the incidence of post-CABG AF. Digoxin and verapamil were found to be ineffective in two of these meta-analyses. Beta-blockers produced an approximate 60% reduction in the risk of post-CABG AF.
Amiodarone reduced the incidence of postop AF in some trial, while others were inconclusive. It remains uncertain when amiodarone would need to be started prior to surgery; it was initiated 7 days preoperatively in one study, which is inconvenient in most situations. Further, amiodarone has a significant potential toxicity.
In the SPPAF (Study of Prevention of Postoperative Atrial Fibrillation) trial, amiodarone plus metoprolol was compared with placebo, metoprolol alone, or sotalol. Both sotalol (32%; $p = 0.013$) and amiodarone plus metoprolol (30%; $p = 0.008$), but not metoprolol alone (40%; $p = 0.16$), were associated with a significantly lower risk of AF compared with placebo (54%). In the REDUCE (REDUction in postoperative Cardiovascular arrhythmic Events) trial, intravenous, followed by oral, amiodarone was compared with oral sotalol; therapy was initiated at the time of surgery. The overall incidence of post-CABG AF was 17% (14 of 83 patients) with amiodarone and 25% (19 of 76) with sotalol ($p = 0.21$). In high-risk patients, however, the incidence of AF was reduced from 82% (9 of 11) with sotalol to 7% (1 of 15) with amiodarone ($p < 0.001$). Sotalol has been compared with conventional beta-blockers in four studies ($n = 900$). The average incidence of post-CABG AF was 22% with conventional beta-blockers and 12% with sotalol. Magnesium has been used to prevent post-CABG arrhythmias. Effectiveness of magnesium in preventing AF has not been impressive.

Treatment:
A large number of drugs have been shown to be more effective than placebo in converting post-CABG AF. These include class IA agents (procainamide), class IC agents (flecainide, propafenone), and class III agents (amiodarone, dofetilide, ibutilide). There are no trials evaluating sotalol for cardioversion of post-CABG AF.

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What is New in Pain Management following Thoracic Surgery?

Boleslav Kosharskyy

Thoracic surgery induces severe postoperative pain and impairment of pulmonary function. A multimodal perioperative pain management decreases the morbidity of the thoracic surgery and improves postoperative reconvalescence. Therefore the adequate and efficient postthoracotomy analgesia is of paramount importance.

Thoracic epidural analgesia is commonly considered the „gold standard“ of the postoperative pain control (1-3). Several other alternative regional methods have become increasingly popular. They include: paravertebral, intrathecal, intercostal, and interpleural analgesic techniques. Systemic opioid therapy along with antiinflammatory agents and antineuropathic medications are also available.

The most recent systematic reviews of randomized trials evaluating regional techniques for postthoracotomy analgesia suggested that either thoracic epidural analgesia with LA plus opioid or continuous paravertebral block with LA can be recommended. Where these techniques are not possible, or are contraindicated, intrathecal opioid or intercostal nerve block are recommended despite insufficient duration of analgesia, which requires the use of supplementary systemic analgesia (1-3). More than 75% of thoracotomy patients report constant severe ache in the ipsilateral shoulder after the surgery. The most effective management strategy would be a combinational approach, including acetaminophen (pre-emptive and regulary), NSAIDS and infiltration of the phrenic nerve with a long-acting local anesthetic (2,8).

Chronic post-thoracotomy pain (CPTP) is defined by the International Association for the Study of Pain as ‘pain that recurs or persists along a thoracotomy incision for at least 2 months following the surgical procedure (4). Different strategies have been suggested to reduce chronic post-thoracotomy pain. These have included nonsteroidal anti-inflammatory drugs, antineuropathic agents, parenteral opiates, epidural and paravertebral infusions of local anesthetics, intercostal and phrenic nerve blockades, and Cryotherapy (5,7). Recently, the implementation of pulsed radiofrequency has shown a tremendous interest in the medical community as a safe and potentially effective treatment for CPTP (6).

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High Frequency Jet Ventilation in Pulmonary Surgery

Miroslav Klain

Jet ventilation has been originally used mostly for emergency airway management taking advantage of its capability to deliver breaths by a small cannula sometimes even by using a transtracheal puncture. But by introduction of high frequency jet ventilation (HFJV) applications have been expanded.

First, high frequency jet ventilation added an element of safety to the method. Because it administers very small tidal volumes, it produces lower airway pressures and decreases significantly the danger of barotrauma by overdistention of the lungs. It also prevents aspiration and can be easily superimposed on spontaneous breathing. It is also capable to ventilate patients with bronchopleural fistula and provide independent lung ventilation.

Second, its utility was shown in cases where the anesthesiologist and surgeon have to share the airways like in endoscopies and upper airway obstruction.

Third, small tidal volumes decrease the movement of the lungs and consequently the movements of internal organs by artificial ventilation in contrast to the movements during standard artificial ventilation or even during spontaneous breathing. It eliminates the cyclical fluctuations of blood pressure seen during artificial ventilation and provides a quiet non-moving field for interventional procedures like radio-frequency ablation.

Finally, high frequency jet ventilation can be used with respiratory frequencies within the range of normal heart rates and can be easily synchronized to the heart beat. Some earlier studies have shown a significant augmentation of cardiac output in heart failure by that approach.

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Anesthetic Management of the Patient with Heart Failure (Noncardiac Surgery)

Nancy A. Nussmeier

Heart failure (HF) has increased to nearly epidemic proportions in the last decade, due to the "graying" of America and the rest of the world, with people living long enough to have gradual deterioration of cardiac function become evident. In the United States, approximately 500,000 people are diagnosed with new HF annually. Strategies for treating end-stage HF aim to limit disease progression, prolong life, and improve quality of life.

The ACC/AHA Classification of Chronic Heart Failure has been developed as a staging scheme, emphasizing the progression of the disease: **A** – High risk for HF (hypertension, diabetes mellitus, coronary artery disease, cardiotoxins, family history of cardiomyopathy); **B** – Asymptomatic HF (structural heart disease such as prior MI, LV dysfunction, valvular heart disease – but no symptoms); **C** – Symptomatic HF (structural heart disease with symptoms such as dyspnea, fatigue, decreased exercise tolerance); and **D** – Refractory end-stage HF (marked symptoms at rest despite maximum medical therapy).

Several adaptive mechanisms come into play when the cardiac output is inadequate to meet metabolic demands. Initially, the left ventricular end-diastolic volume increases, which causes an improvement in pump function and cardiac output via the Starling mechanism. Sympathetic activation leads to elevation of circulating catecholamine concentrations, with increased heart rate and excessive peripheral vasoconstriction, as well as activation of the renin-angiotensin-aldosterone system, with increased sodium retention. Over time, these neurohumoral responses become maladaptive, resulting in pulmonary congestion and excessive systemic afterload. The left ventricle dilates and hypertrophies, a change in its geometry occurs, and it becomes more spherical (ventricular remodeling). Vasopressin becomes an important vasoconstrictor, since chronic activation of the sympathetic nervous system leads to a vasopressin-deficient state.

Patients with Stage C HF are defined as having current or prior symptoms of HF (e.g., dyspnea, fatigue, and reduced exercise tolerance) associated with underlying structural heart disease. Patients at this stage are treated with drugs, such as angiotensin-converting enzyme (ACE) inhibitors, angiotensin receptor blockers (ARBs), aldosterone-receptor blockers, β-blockers,

digoxin, and diuretics. Often, they have had cardiac resynchronization therapy (CRT) or placement of an automatic implanted cardioversion/defibrillation device (AICD).
As the average age of the population increases, anesthesiologists will be confronted more frequently with patients with advanced HF and with patients who have had relatively new and innovative cardiology interventions or surgical procedures for HF. The perioperative management of patients with Stage C heart failure undergoing noncardiac surgery will be addressed in this lecture.

Surgical Interventions for Heart Failure

Alina M Grigore

Congestive heart failure (CHF) is a pathophysiologic state of inadequate myocardial contraction and/or relaxation leading to decreased cardiac output and inadequate organ perfusion. Strategies for treating end-stage CHF aim to improve quality of life, limit disease progression, and prolong life. When multidrug regimens could not prevent progression toward end stage CHF there is a greater than 75% two-year mortality risk, with surgical intervention being the only effective treatment. According to ACC/AHA guidelines, the only established surgical treatment option for advanced heart failure is transplantation (1).

Cardiac Transplantation
In the United States, cardiac transplantation is performed in member centers of the United Network for Organ Sharing (UNOS), an umbrella organization responsible for coordinating organ procurement, organ allocation and statistical information. Certainly, cardiac transplantation represents the definitive therapy for terminal CHF; it is associated with excellent 1-year survival (>80%), 5-year survival (60%), and functional capacity (2). However, whereas over 10,000 patients are on a heart transplant waiting list, less than 2200 donor hearts are available each year (3). The mismatch between the increasing number of potential candidates for cardiac transplantation and the relatively fixed number of donors, as well as the large number of acute CHF deaths mandated alternative surgical therapies including the use of ventricular assist devices (VADs).

Ventricular Assist Devices
Some important factors need to be taken into consideration during *device selection* process, such as: the expected duration of support, type of support needed (right, left or biventricular assist), overall cost, device-related mobility, and FDA approval status. The latest *indications* for mechanical assistance include reversible ventricular dysfunction occurring after cardiac surgery, bridge to heart transplantation, destination therapy for nontransplant candidates. The use of mechanical assist devices as bridges to cardiac transplantation has been found to improve the survival rates and outcomes of patients with decompensated heart failure (4). In addition, long-term left VAD support has proven to be superior to optimal medical treatment in patients with end-stage CHF who are not candidates for heart transplantation (4). Thus, mechanical assistance has become an important tool in the surgical management of patients with failing hearts.

New VAD Systems in Clinical Trials
There are three new VAD systems that have recently been introduced into clinical trial. The HeartWare, Ventracor and Levacor devices are all third generation magnetically levitated devices. Currently, HeartWare LVAD has been implanted in 19 patients in Australia and Europe with excellent results, only few deaths and most of the remaining patients on continuous support. United States clinical trials for this device are anticipated to begin in that later part of 2007. The Ventracor LVAD clinical trials are also underway in Australia. Circulite pump is small, presents the potential of being implanted percutaneously, and has been recently used in 2 patients during the past few months. The Levacor LVAD should begin trials in the near future.

Expanding VAD Therapy
VAD therapy has been used in the most severely ill patients, which has resulted in complication and survival rates that are seemingly less than desirable. The current consensus among VAD developers is that this therapy is ready for use in a “less sick” population of patients, i.e. NYHA class IIIb. A key step toward more efficient clinical trials is center participation in the Intermacs VAD registry.

Recovery
Recently, clenbuterol, a β_2 adrenergic-receptor agonist, has been studied in a number of centers in Europe and the US (5). Reverse remodeling was reported with prolonged LV unloading with the use of LVAD in con-

junction with administration of clenbuterol in order to prevent myocardial atrophy (6). In addition, there are a few research groups currently conducting basic research to identify which stem cells can be used to enhance myocardial recovery during VAD support. Recently, a group of researchers have developed cells contracting in-vitro. Techniques for implantation or transplantation of such cells are being perfected.

Total Artificial Heart

SynCardia CardioWest TAH is a biventricular orthotopic pulsatile pump pneumatically driven. Each ventricle has a seamless blood-contacting diaphragm, two intermediate diaphragms and an air diaphragm made of polyurethane and separated by thin coatings of graphite. The inflow (27 mm) and outflow (25 mm) Medtronic-Hall valves are mounted on the housing. The ventricles fully fill and eject 70 ml/beat. Currently, CardioWest is the only total artificial heart device in use for bridging to heart transplantation (7). Sixty eight percent of the transplant candidates patients treated with this device survived long-term (8). Recently, CardioWest was successfully used in a restricted group of patients with irreversible cardiogenic shock. Patients recovered all dysfunctional organs and were successfully transplanted (9).

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The Role of Calcium in Heart Failure

Michael Howie

Over the recent years mitochondria have taken center stage as remarkably autonomous and dynamic cellular organelles, that are intimately involved in orchestrating a diverse range of cellular activities. Throughout adult life mitochondria provide mechanisms to adapt to various stress conditions and ultimately they have the power to determine cell death. The emergence of this picture follows inevitably from recognition of mitochondria as the "powerhouse of the cell," a role intimately and flexibly coupled to ion transport processes across their double membrane barrier.

Calcium has to cross two membranes to enter the mitochondrial matrix, the selective barrier offered by the inner mitochondrial membrane (1MM) has been recognized for many years, but the role of the outer membrane (OMM) as a regulated Ca^{++} barrier has only recently been recognized. There is a cohesive model of Ca^{++} handling based on the cooperation of three modules: Ca^{++} uptake from the extra mitochondrial space, buffering in the mitochondrial matrix and calcium extrusion into the surroundings.

Calcium cycling defects have emerged as a critical form of molecular dysfunction that directly contributes to contractile dysfunction and associated malignant arrythmias in failing hearts.

Periodic cytosystolic Ca^{++} oscillations named calcium transients fundamentally govern contraction and relaxation in cardiomyocytes. Membrane depolarization triggers Ca^{++} influx through L-type Ca^{++} channels (LTCC) followed by Ca^{++} release through the ryanodine receptors into the sarcoplasmic reticulum. Although the LTCC is rapidly inactivated by local elevation and sustained membrane depolarization, transiently induced cytosolic Ca^{++} bines to the thin filament troponin C and activated the contractile machinery. Sarcoplasmic reticulum Ca^{++} is being depleted, the ryanodines are inactivated switching the cardio myocyte from systolic to diastolic mode. Altered phosporylation in failing hearts by a compensatory mechanism to increase cardiac output eventually becomes mal-adaptive and further leads to deleterious Ca^{++} homeostasis. Molecular targeting of phosphoregulatory proteins can be potentially therapeutic targets for heart failure.

Myocardial protection with Levosimendan?

Uwe Schirmer

Levosimendan is in wide use in European countries and approved for treatment of acute decompensated heart failure in more than 40 countries (but not in Germany).

Levosimendan is recommended for treatment of acute heart failure (degree of recommendation IIa, evidence

level B) by the ESC/ESICM Executive summary guidelines since 2005 (1). It is recommended as an optional drug (but without evidence) for the treatment of chronic heart failure also (2). Its positive inotropic activities are well described and due to a myocardial calcium sensitization action. However, Levosimendan is a potassium channel agonist also and opens ATP-sensitive potassium channels (K_{ATP}-potassium channels) (3). In coronary arteries (4), in the arterial vascular bed (3) and in the venous vascular bed (5) this causes vasodilatation. But Levosimendan activates mitochondrial K_{ATP}-potassium channels also (3, 6) and the activation of *mitochondrial* K_{ATP}-potassium channels has been shown to act against ischemia reperfusion damage (7,8).

In experimental and clinical investigations, Levosimendan has been shown to protect the myocardium by preconditioning (which is similar or even better compared to ischemic preconditioning) and to reduce the size of an experimentally induced myocardial infarction (9-12). It has been used successfully in cardiac surgery patients (13-15) and is recommended as „possible alternative if preconditioning could be beneficial“ (6). It is to be expected that Levosimendan will play an important role not only in cardiac surgery (11,16,17) but also in non-cardiac surgery patients (18). Furthermore, since KATP potassium channel activation may be protective to other organs also (9), it is not surprising that protection of the spinal cord (19), the kidney (20) or the lungs (21) has been reported. With all these features and successful reports we can only wonder whether Levosimendan is *„..a perpetuum mobile?“* (22) or *„..the magic drug?“* (23).

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What Every Anesthesiologist should Know about the Atrial Septum

Barry Love

The atrial septum is a wall composed of several embryologic “parts” that separates the right and left atria. In adulthood, the atrial septum is usually completely intact. In a significant proportion of patients however, a patent foramen ovale (PFO) – which is a door in the wall – remains. Less commonly, a true “hole” or atrial septal defect exists and this may be found in many different parts of the atrial septum.

The implications of patent foramen ovale and atrial septal defect as they pertain to the practice of anesthetic care in various cardiac and non-cardiac surgical settings will be discussed. Highlights to include:

1) Evaluation of the atrial septum by intraoperative transesophageal echocardiogram. The defects you, your patient, and your malpractice lawyer don’t want you to miss.
2) Pre-operative assessment for PFO/ASD. Which patients should have the atrial septum evaluated preoperatively and why.
3) Anesthetic management in patients with PFO/ASD. What precautions should be taken?
4) Anesthetic issues that arise during surgical and transcatheter ASD closure. The words “simple and routine” should be stricken from the physician’s vocabulary.
5) The atrial septum during ECMO and VAD support. When you want a hole and when you don’t.

Morphine – A Better Opioid for Cardiac Surgery?

Glenn S. Murphy

Opioids are frequently administered to cardiac surgical patients. The use of high-dose morphine (1-3 mg/kg) for cardiac surgical procedures was first described by Lowenstein et al. in 1969 (1). The administration of large doses of morphine was generally abandoned following the introduction of fentanyl into clinical practice, since high-dose fentanyl (50-100 μg/kg) was not associated with hypotension on induction of anesthesia (2). At the present time, lower-dose fentanyl (5-15 μg/kg) is commonly administered to fast-track cardiac surgical patients, whereas morphine is used primarily for postoperative pain control.

The use of morphine intraoperatively as part of a balanced anesthetic technique may provide several potential beneficial effects during the perioperative period. Studies in animal models have demonstrated that the administration of morphine prior to or following a period of myocardial ischemia results in a significant reduction in infarct size (3,4). In contrast, laboratory studies have observed no reduction in myocardial injury when fentanyl is administered prior to an ischemic insult (5,6). In patients undergoing CABG surgery, cardiac function was preserved in patients randomized to receive morphine as part of a balanced anesthetic technique, whereas myocardial performance was significantly worsened in subjects administered fentanyl (7). Similarly, in patients undergoing percutaneous coronary interventions, cardioprotective effects have been observed following morphine administration, but not with fentanyl premedication (8,9). A greater affinity of morphine than fentanyl for the δ-opioid receptor may explain the differences in cardioprotective effects (5).

Data has also demonstrated that morphine has unique anti-inflammatory properties, which are not shared by other clinically-used opioids. The μ^3 receptor is a morphine-selective opioid receptor located on monocytes and granulocytes which is involved in immune and inflammatory processes. Pretreatment of activated granulocytes and macrophages with morphine significantly attenuated cytokine production and expression of adhesion molecules (10,11). In a pig model of CPB, the administration of morphine diminished activation of inflammatory cells (12). Fentanyl does not bind to the μ_3 receptor and does not downregulate inflammatory cell function (13,14). In a clinical investigation of cardiac surgical patients, subjects randomized to receive morphine had lower levels of IL-6 and CD 11b/CD18 expression compared to those administered fentanyl (15). Furthermore, the incidence of postoperative hyperthermia was significantly reduced in the morphine group.

Early clinical trials suggest that morphine may enhance clinical recovery following cardiac surgery. Further studies are needed to determine if postoperative outcomes are improved when morphine is used intraoperatively as part of a balanced anesthetic.

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Blood Conservation in Cardiac Surgery: Why and How?

M. Arisan Ergin

Transfusion of allogeneic blood during cardiac surgery is a major health issue. In the US about 20% of the nation's blood supply is consumed during cardiac surgery. The use of blood products after cardiac surgical interventions varies from 10% to 100% despite published transfusion guidelines. The substantial rate of allogeneic blood product utilization in cardiac operations raises concerns of associated morbidity such as hemolytic or allergic reactions, infections (human immunodeficiency virus, cytomegalovirus, hepatitis), graft-versus-host disease, transfusion related lung injury and an increased incidence of postoperative infections. Taken together, these complications represent substantial human and financial costs. There is also recent evidence that suggests that transfusion during cardiac surgery is associated with reduced longevity.

Advances in perioperative techniques have called for a reevaluation of transfusion management during these procedures. We have instituted a blood conservation program that has the potential to markedly alter the current paradigm concerning allogeneic blood use in cardiac surgery. By identifying a patient's risk for transfusion, perioperative management can be altered to minimize the risk for transfusions and assist in proper blood ordering practices. At Englewood Hospital and Medical Center, a comprehensive blood conservation program is practiced in all patients. This program includes (1) preoperative optimization of hemoglobin, (2) intraoperative acute normovolemic hemodilution (ANH), (3) autotransfusion, (4) tolerance of anemia, (5) meticulous surgical technique, (6) endovascular vein harvesting, (7) on-site coagulation monitoring (thromboelastography and heparin concentration determination), and (8) targeted pharmacotherapy (antifibrinolytic agents and desmopressin acetate).
With this multimodality approach to blood conservation in 1414 patients the overall transfusion rate was 18% (16% excluding aneurysms). In 707 CABG patients 11.9% were transfused (only 4% of patients with a pre-op Hgb > 13gm/dL were transfused). These remarkably low transfusion rates were achieved without any apparent increase in mortality or morbidity. A cost analysis of this approach shows that this comprehensive blood conservation practice is not only cost effective but might be a bargain if the cost of the recently documented hidden morbidity associated with transfusions is factored into the equation. This experience supports the argument for a critical reassessment of and change in blood transfusion practices in cardiac surgery.

Immunologic Profile of Open Heart Surgery

Martin Stritesky

The incidence of MODS following cardiopulmonary bypass was 11% with a mortality rate of 41% in these patiens.
Many aspects of a patient's risk of serious perioperative complications are perceived as being relatively fixed (genotype, preoperative health status, surgical difficulty, etc). On the other hand cardiac surgery provokes a vigorous inflammatory response, which has important clinical implications.
Factors influencing incidence, severity and clinical outcome of the inflammatory response are currently not well understood.
Clinically, patients usually show two to three of the four symptoms,which define the so-called systemic inflammatory response syndrom. In addition, all parameters of the innate, nonspecific immune system (e.g., polymorphonuclear cells, elastase and complement) are activated. This also applies to the pro-inflammatory mediators IL-1, IL-6, IL-8, and tumor necrosis factor α. Within the adaptive, specific immune system, a decrease of T-lymphocytes and T-helper cells is observed, whereas suppressor/cytotoxic T cells and B cells appear to be nearly unaffected. Cytokine measurements provide more detailed information; IL-2 and I-12, which are important for the activation of the type 1TH cell-mediated immune response, are depressed following cardiac operations. In contrast, IL-10 and transforming growth factor-β, essentials to TH-2 mediated humoral or anti-inflammatory immune response, are upregulated.
Therefore, more information is needed about the immune response of patients at high preoperative risk or with serious perioperative complications to find out whether clinically relevant events are correlated to alterations of immune response.

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Inotropes in Cardiac Surgery – Where is the Evidence?

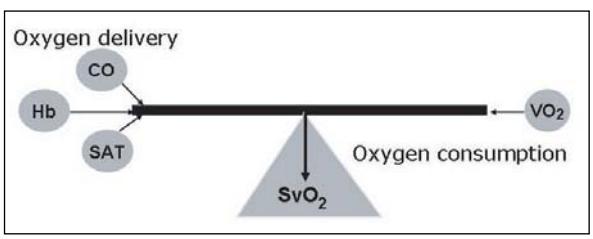
Carl-Johan Jakobsen

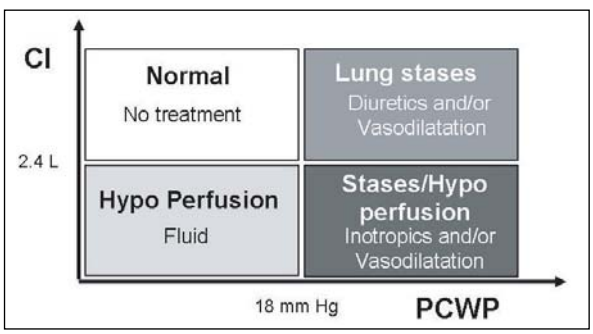
Cardiac Surgery is often followed by impaired myocardial function. The literature does not reveal evidence based prescriptions of how to handle weaning from CPB and the postoperative treatment. Consequently treatment is guided by patients' condition, concurrent diseases, monitoring status and the local policy. Analysis of more than 4000 patients from our

institution reveals that the major contributing factor in using inotropics is the anesthesiologist and not type of surgery, EuroSCORE or co-morbidity. The challenge facing cardiac surgery includes that most seem to know "how to do it right" and that our knowledge of individual drugs is high but few really know "the full story".

A fundamental basis of treatment must be based on established need for treatment. Thus monitoring of the hemodynamic system is unavoidable. Despite the fact that cardiopulmonary catheters (CPC) are still widely debated, they deliver some relevant data and make room for simple treatment models. Recently, we demonstrated an unexpected high preoperative intrapatient variation in hemodynamic variables (1). As routine preoperative monitoring is impossible for obvious reasons our findings indicate difficulties in acting on single hemodynamic variables and further indicate that goal oriented therapy may result in over treatment compared to preoperative status. Consequently, postoperative treatment must be based on several variables combined with other monitoring techniques, such as visualizing cardiac function by echocardiography.

It has been advocated to keep SvO_2> 70% and s-lactate ≤ 2 mmol/l[2]. The primary positive outcome from this study was significantly shorter hospital length of stay but the groups were not fully comparable as a substantially higher number of procedures known to have longer hospital stay were in the control group. However, we probably all agree that a CI < 2.0 l/min and SvO_2 < 50 needs some kind of support. A simple treatment model can be established from the hemodynamic measurements. The principal task is to set the cut off values for treatment dependent of i.e. pre-operative status and age. Treatments can be either mechanical (intra aortic balloon pumping/pacemakers) or medical (inotropics/vasodilatators/vasoconstrictors). It is imperative, that the model should be used to set individual goals for the individual patients.





All inotropic drugs increase both oxygen delivery and oxygen consumption, and one has to recall that the increase in consumption could deteriorate the cardiac perfomance. Basically most inotropics/vasoconstrictors have the same mode of action, although with different preference for organ receptors, and thus different overall hemodynamic effect. From the literature it seems that one of the predominant factors is to find the optimal drug which increases oxygen delivery more than oxygen consumption.

The most frequent finding in the postoperative phase, is intravascular fluid depletion despite a general fluid overload. The time with impaired hemodynamics after cardiac surgery is often relatively short and as most patients have an adequate oxygen delivery/consumption balance without stimulation, the majority of patients should likely manage without inotropics, or at least only small bolus doses of adrenaline/noradrenaline. However, if there is need for continuous support, Milrinone or Amrinone seem to be optimal inotropics. However the dilatatory effect often requires supplement with i.e. noradrenalin, which could neutralize the positive cardiac effects.

Inotropic treatment of patients with heart failure has been questioned in a meta-analysis (3). Further, as preoperative values mostly are unknown and with great variance (2), and as the number of randomized studies on cardiac surgery patients are few or lacking, it still remains to be proven that supra-normal oxygen delivery improves outcome after cardiac surgery.

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Minimally Invasive Cardiac Surgery: The NYU Experience

Marc Kanchuger

Port Access Cardiac Surgery was pioneered at NYU starting in 1996. We will review 3732 of these cases performed between 1996 and 2007. Minimally invasive cardiac procedures performed were Mitral, Aortic, Tricuspid, ASD, VSD, CABG and tumor removal. We will trace the development of the technique from its conception of a catheter based bypass technique to the method employed presently.

The anticipated advantages were less pain, less blood loss, decreased hospital stay, and better cosmetics for the patient. Most of these were proven to be true over time. The comfort zone for the surgeon and anesthesiologist was made smaller by these techniques, and tips to improve that zone will be discussed.

The Heartport technique was originated by the team from Stanford, along with collaboration by other groups. It initially involved a long venous drainage cannulae, femoral aortic cannulae, intra aortic balloon cross clamp, and PA vent. A coronary sinus catheter was placed by the anesthesiologist transvenously via the jugular vein as well. Fluoroscopy and TEE were required. We simplified the technique today to use only the long venous cannulae in some cases, and all else is now accomplished with direct cannulation, TEE and no fluoroscopy. This standardized procedure is key to making it easier for teams around the country to adopt the minimally invasive techniques.

The early techniques, as well as today's techniques will be discussed. The rationale for the evolution outlined, the most recent data on these cases will be presented, and the direction for the future discussed.

Mitral Valve Repair – Results

Cid S. Quintana

Mitral valve repair has been the procedure of choice for the treatment of mitral valve insufficiency, regardless of etiology.

A ten-year experience involving ninety-two consecutive patients undergoing mitral valve repair will be summarized.

All of the operations have been performed following the Carpentier techniques of mitral valve repair with only minor modifications.

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Cardiac Surgery in Geriatric Patients

Javier G. Castillo

The average age of the population of the United States is steadily increasing. In 2008, life expectancy in the USA is 78 years (76.2 years in males and 81 years in females). It is estimated, that the number of people aged 80 and older will exceed 20 million by 2020. Cardiovascular diseases (CVD) including coronary artery disease and valvular diseases are significantly more prevalent in the elderly population.

In 2005, CVD was the leading cause of death. By 2015, almost 20 million people will die from CVD particularly among the elderly patients. Therefore, an increasing number of these patients will require cardiac anesthesia and surgery for the treatment of their condition. Thorough preoperative assessment, optimal preparation, and identification of the risk factors for perioperative morbidity and mortality in the geriatric population are critical. Age related changes in co-morbidities and altered pharmacokinetics and pharmacodynamics will influence every aspect of anesthetic management, monitoring, medication, postoperative care, and surgical outcome.

This presentation will summarize the most updated research outcomes regarding the age-related changes in organ subsystems relevant to cardiac anesthesia, perioperative issues, and intraoperative management. Additionally, early and late operative outcome in octogenarians undergoing coronary revascularization, aortic surgery and mitral valve surgery will be reviewed.

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Selecting Open or Endovascular Repair for Carotid Stenosis and AAA

Peter L. Faries

Minimally invasive endovascular therapies are currently being used to treat a wide array of vascular diseases. Areas in which significant advances have been made are carotid artery stenosis and abdominal aortic aneurysms (AAA). Multiple factors may be considered in the selection of open or endovascular techniques for the treatment of carotid stenosis and AAA.
Recent studies have indicated that carotid angioplasty and stenting (CAS) may be used effectively to treat patients with carotid artery stenosis who are considered to be at increased risk for standard surgical carotid endarterectomy. Increased risk may be present as a result of physiological factors, most commonly coronary artery disease and severe pulmonary disease. Anatomic factors may also increase the risk of standard surgery. These factors include prior neck surgery and neck irradiation. The success of CAS is dependent on appropriate pharmacological and anti-platelet management and perhaps most importantly on the development of cerebral protection devices. Using these techniques a reduction in the combined stroke/death/MI rate has been achieved in high-risk patients as compared with carotid endarterectomy. For patients who are considered to be at standard risk for carotid endarterectomy, CAS has not been demonstrated to be advantageous. The CREST trial is a multicenter, randomized study sponsored by the NIH which is currently being conducted to evaluate CAS and carotid endarterectomy in the treatment of standard risk patients. The results of this trial are likely to influence the selection of the technique used to treat patients with carotid stenosis.

The development of endovascular techniques for the treatment of AAA has significantly reduced the morbidity, length of stay and in hospital mortality associated with conventional surgical repair. The indications for the use of endovascular grafts continue to expand as additional experience is gained. While endovascular therapies were initially used preferentially in high surgical risk patients, they have become the standard of care for all patients presenting with suitable anatomy. Anatomic limitations for the use of endovascular grafts originate predominantly from two areas: The proximal implantation zone and the iliac access vessels. The success of endovascular treatments is dependent on excluding the AAA from the arterial circulation. This eliminates pressurization of the aneurysm and thereby prevents rupture. Apposition of the endovascular graft to a normal segment of the aortic wall proximal to the aneurysm is necessary to achieve exclusion. Angulation or dilatation of the aorta at the level of proximal implantation may prevent the achievement of a hemostatic seal. In addition, since the endovascular graft is brought into position through the iliac arteries, significant occlusive disease of these vessels may prevent delivery of the device. Overall, in properly selected patients endovascular grafts have proven to be effective in preventing aneurysm rupture and death in short and intermediate term follow-up.

Management following Major Aortic Reconstruction

Brigid Flynn

Postoperative care of patients following major aortic repair requires knowledge of not only routine cardiac surgery postoperative care, but also of concerns specific to ascending and descending aortic repairs. Postoperative management in cardiac and aortic surgical patients involves sedation management, inotropic support, bleeding management, vasopressor and/or vasodilator use, monitoring of renal function and ventilator management, which in the case of thoraco-abdominal (TAA) repairs, involves recovery from one-lung ventilation.
Ascending aortic repairs require stringent blood pressure monitoring along with strict control. Hypertension should be avoided postoperatively. Neurologic complications, notably postoperative stroke, must be diagnosed and managed expeditiously.

Concerns specific to descending aortic and TAA repairs will be discussed. Firstly, spinal cord perfusion can be jeopardized secondary to dissection of intercostal arteries. In order to maintain spinal cord perfusion pressure (SCPP) at optimal values, important goals must be met including: elevated mean blood pressure to 85-95 mmHg, decreasing intrathecal pressure to less than 15 cmH_2O and minimizing venous pressure.

These goals are accomplished via the many monitoring devices placed intra-operatively including an arterial line, an intrathecal catheter and possibly an intercostal artery catheter, placed in the T12 or L1 intercostal artery. Slow re-warming is essential as it decreases spinal cord metabolic rate. Avoidance of nitroprusside in order to prevent intercostal artery "steal" is practiced. Steroids given intra-operatively and continued postoperatively to decrease neuronal inflammation, thereby further enhancing SCPP. Somatosensory evoked potentials can be used intra- and postoperatively to assess spinal cord function.

Cardiac Surgery & Anesthesia: Past, Present & Future

Davy C. H. Cheng

Learning Objectives:

At the end of the lecture, the participants will appreciate the Past, Present and Future for the development and advancement of cardiac surgery & anesthesia in:

1. Cardiac pharmacology and technique
2. Organs monitoring and protection
3. Cardiopulmonary bypass and coagulation management
4. Minimally invasive cardiac surgery

Case Report: Spontaneous Hemothorax during General Anesthesia

Bijal R. Parikh, Rouzbeh Sattari, Nazly M. Shariati, Robert S. Dorian
Saint Barnabas Medical Center, Livingston, NJ – Department of Anesthesia

Introduction:
Spontaneous hemothorax is a rare entity. It is even more uncommon during general anesthesia. To our knowledge there is only one reported case of spontaneous hemothorax during general anesthesia. We report a case of spontaneous hemothorax in a healthy 27 year old male undergoing elective reconstruction of the right anterior cruciate ligament (ACL) under general anesthesia.

Case Presentation:
Following the reconstruction of ACL, in the post anesthesia care unit (PACU), the patient became hypotensive and tachycardic with mid sternal chest discomfort. A chest roentgenogram revealed an almost complete opacification of the right hemithorax. A diagnostic thoracentesis was positive for frank blood confirming a right hemothorax. The patient was emergently taken back to the operating room. A chest tube was inserted and drained 3.3 liters of dark blood. Once the patient improved hemodynamically, we proceeded with a right video-assisted thoracoscopic surgery (VATS). During exploration of the right thoracic cavity a bleeding vessel incorporated in a bleb was identified at the apex of the right lung. The bleeding vessel was clipped. A wedge resection of the apical bleb was performed and the associated torn vascular adhesion was stapled. The patient was found to have multiple blebs at the apical region of the right lung.

Discussion:
Blebs, also known as bullae, are air-filled lung cysts within or contiguous to the visceral pleura. Bullae can undergo neovascularization and form vascularized bullae. Rupture of these vascularized bullae can cause a spontaneous hemopneumothorax (SHP). SHP is a rare event occurring in young patients with a male predominance. Bullae can rupture during positive pressure ventilation secondary to barotrauma. In our patient it is possible that an apical vascularized bleb ruptured causing a massive bleed. However, only a hemothorax (and not a hemopneumothorax) was appreciated on chest roentgenogram. This might be explained by the large amount of intrapleural blood and subsequent clot formation which may have formed a cap on the ruptured bulla stabilizing the pneumothorax. In our patient it is possible that an apical vascularized bulla ruptured causing a massive intrapleural bleed. Ruptured vascular bullae causing an intrapleural bleed is well documented but has never been reported during general anesthesia.

The Use of Multi-modality Simulation in the Retraining of the Physician for Medical Licensure

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Introduction:
Patient simulation has been widely incorporated into the educational programs of many anesthesiology residencies. This educational technique has been recognized by the Accreditation College of Graduate Education (ACGME) as an effective tool to teach domains of competency. Here we report the novel use of simulation for both retraining and evaluation of a physician seeking medical licensure.

Case Description
The New York State Society of Anesthesiologists (NYSSA) and Office of Professional Medical Conduct (OPMC) of the New York State Department of Health have, in the past, solicited the MSSM (Mount Sinai School of Medicine) in the evaluation and development of a remediation program for a dyscompetent anesthesiologist (1). A non-practicing anesthesiologist, whose medical license was revoked ten years prior due to non-medical reasons, was mandated to participate in a retraining program before his license would be reinstated. The physician contacted The Department of Anesthesiology to develop and conduct the program.
A six-week simulator-based retraining program was developed that included basic and advanced clinical skills education and assessment. The topics included: anesthetic induction, anesthetic emergence, perioperative hypoxia, perioperative hypotension, dysrhythmias, and the difficult airway. The physician attended simulator sessions three times each week followed by debriefing sessions. Coincidentally, the program occurred in July and the physician attended an introduc-

tory lecture series of twenty topics developed for first year anesthesiology residents.

Discussion:
After retraining, a competency assessment was developed using four simulations and two standardized examinations (the Anesthesia Knowledge Test 6 and 18). During each scenario two raters independently scored the physician's performance in terms of the six domains of competence as outlined by the ACGME (i.e., medical knowledge, clinical skills, professionalism, interpersonal skills and communication, practice-based learning and improvement and systems based practice). Competency was not determined per se, but whether or not the physician practiced within the standards of care in a simulated environment.
During the retraining program the candidate demonstrated significant improvement and modernization of practice. He did, however, demonstrate lapses in knowledge of current ACLS protocols and complex medical issues. Performance on the standard examinations also revealed lapses in knowledge. As such, his performance during the retraining and assessment supported the recommendation that he begin clinical practice in a supervised environment. He returned to the practice as a fellow in another training program and the OPMC subsequently reinstated his license.

Conclusions:
Retraining a physician whose ability to safely practice anesthesiology is in question is a complex process regardless of the reason for lapsed competence. Credentialing bodies must be fair but also seek as many useful pieces of data as is reasonable to ensure a physician does not pose a risk to patients if allowed to return to clinical practice. Since simulation has been shown to be an effective tool in the training of anesthesia residents (2,3) it follows that simulation can be used to retrain physicians with lapsed competency. In this physician's case, simulation-based retraining was a crucial component in reinstating his license.

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The Use of a Novel Intravascular Temperature Modulation Catheter for Perioperative Care in Cardiac Surgery

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Introduction:
Temperature management during the perioperative period can be a challenge for complex cardiac surgery. We herein report the use of a novel warming/cooling catheter for a clinical series of six patients.

Case Presentations:
The *first case* is that of a 72-year-old male with severe COPD who underwent emergent repair of an aortic arch dissection requiring hypothermic circulatory arrest. The *second case* is that of a 58-year-old male with end-stage cardiomyopathy who underwent elective Heartmate LVAD insertion for Destination Therapy. The *third case* is that of a 78-year-old female who underwent salvage RVAD insertion for an acute right ventricular infarct with cardiogenic shock. This patient's temperature curve is depicted in figure 1. The first three cases were performed with the intravascular catheter inserted during the operation so as to achieve and maintain normothermia in the early perioperative period.

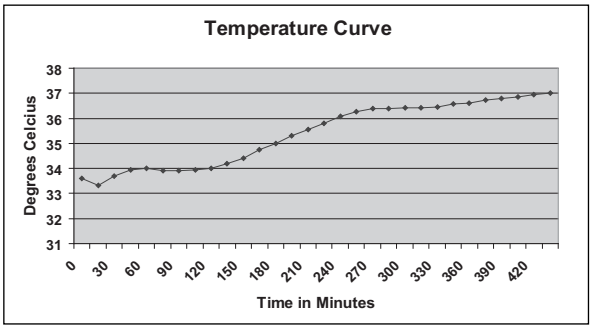

Fig. 1: Case number 3

The final three cases illustrate the use of the percutaneous catheter for cooling purposes. A *fourth case* is that of a 56-year-old male who underwent urgent coronary bypass surgery and mitral valve repair, but suffered a full cardiac arrest after induction requiring cardiopulmonary resuscitation. In this patient, the intravascular catheter was used to cool the patient to 33 degrees for 48 hours after surgery to allow recovery from his perioperative stroke and seizures. A *fifth case* is that of a 62-year-old male presenting with an acute type A dissection and paralyzed, mottled lower extremities. The patient underwent dissection repair. After his perioperative bleeding subsided, the patient underwent cooling to 33 degrees for 48 hours in an attempt to minimize his spinal cord injury. As of 3 months postoperatively, the patient is still recovering but is gradually recovering neurologic function of his lower extremities. The *sixth case* is that of a 74-year-old female with numerous comorbidities who underwent an uneventful CABG. On postoperative day 1, the patient suffered a dense focal stroke. She immediately underwent therapeutic hypothermia for 48 hours and then recovered completely. See figure 2 below.

Discussion:
In all six cases, precise control of perioperative temperature allowed for a smooth perioperative recovery. This clinical experience has paralleled results achieved in our porcine hypothermia model. All six patients have survived and were discharged home. Further studies are indicated to determine under which clinical circumstances this temperature regulation system would be of most benefit.

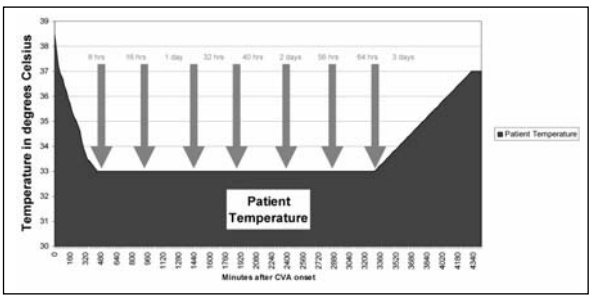

Fig. 2: Case number 6

Use of a Novel Percutaneous Warming Catheter as a Protection Against Perioperative Hypothermia in a Porcine Model

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Introduction:
Hypothermia has been consistently linked with numerous perioperative morbidities. Although numerous techniques exist to prevent or treat hypothermia, none is ideal.

Hypothesis:
The purpose of the present study is to evaluate the effectiveness of a novel rewarming catheter as a protection against hypothermia perioperatively.

Methods:
Two sets of paired 100 kg pigs (n=5 in each group) were cooled on cardiopulmonary bypass to achieve an equilibration temperature of 33° Celsius. See figure 1. In Group C (Control), cardiopulmonary bypass was weaned at that temperature and the animal was allowed to thermoregulate on its own. The swine were left exposed to the environment, and ambient temperature was kept at 21 to 22 degrees Celsius. In Group E (Experimental group) the animals underwent the exact

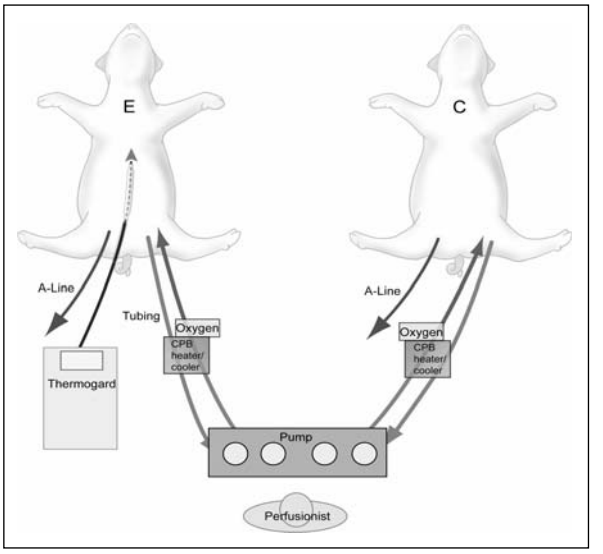

Fig. 1: Experimental Setup

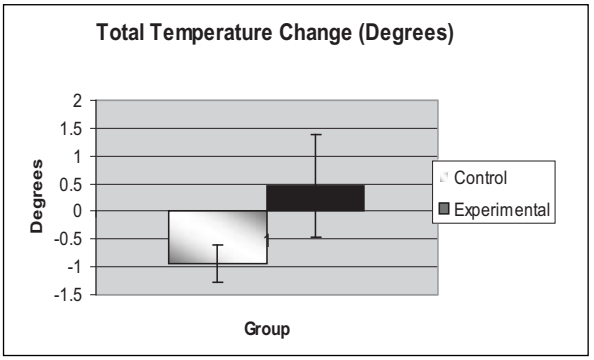

Fig. 2: Total temperature change

same protocol as that described for Group C, with the addition of one intervention: the percutaneous insertion of a rewarming catheter via the right femoral vein and its subsequent activation. During the rewarming phase, nasopharyngeal temperature, ambient temperature, blood pressure, and pulse rate were recorded every 15 minutes for a period of 3 hours.

Results:
The mean change in temperature from the 33° C baseline to the end of the 3-hour study was -0.94° C for the control group and +0.46° C for the experimental group. See figure 2. The difference in the final mean temperature of 1.4° C was highly significant by the paired T-test. Moreover, all 5 animals (100%) in the control group demonstrated a signifiant drop in body temperature (defined as >0.3° C drop in temperature) over the rewarming period in contrast to none (0%) in the experimental group. Using Fischer's exact test, this difference was highly significant (p=0.008).

Conclusion:
Use of an intravascular rewarming catheter provides superior protection against hypothermia in an adult porcine model of hypothermia. The experimental model was designed to provide a particularly challenging barrier for rewarming.

Complications of the Intraaortic Balloon Counterpulsation

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Introduction:
Intraaortic balloon counterpulsation (IABC) uses the principle of diastolic counterpulsation, which augments diastolic coronary perfusion pressure, reduces systolic afterload, favorably affects the myocardial oxygen supply-demand ratio and augments cardiac output (1). From the first clinical performance by Kantrowitz in 1968 (2), use of the IBAC for circulatory support has gained widespread acceptance. Despite technical advances (3, 4) that have simplified and expanded its use, complication rates remain significant. The aim of this study was to assess the risk of iatrogenic significant complications caused by IABC and to identify clinical and procedural variables that would successfully avert a fatal course.

Methods and results:
This paper presents a retrospective review of our experience with IABC during the last decade. A total of 13.795 cardiosurgery operations were performed at the Cardiocentre of IKEM, Prague, from January 1998 to September 2008. Out of these, IABC was applied in 460 cases (3,33%). From this group of 460 counterpulsated patients, 314 (68,92%) were successfully treated, and 143 have died (31,08%). Out of the 460 counterpulsated patients, fatal iatrogenic damage – an aortic dissection – was found in three cases (0,6%). Two of these patients have died, one is still alive and well. These three cases are described in the presentation.

Conclusion:
The fatal complications of the three (out of 460 or 0.6%) mentioned cases directly related to insertion and use of IABC in a group of critically ill patients appear to be acceptable (5,6). Complications resulting of malpositioning of the IABC balloon are generally rare (8,9,10), third case demonstrates that IABC can cause mechanical abdominal arterial branch obstruction. It is important that the critical care nurses have an awareness of the potential complications of IABC. Early detection and rapid intervention will serve to decrease the incidence of more serious and devastating complications associated with the use of IABC (7). Evalua-

tions using Doppler echography are useful in detecting such complications.
We conclude that artery occlusion induced by IABC related to iatrogenic dissection can be safely treated by implanting stents.

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Surgical Correction of Complications Developed during Percutaneous Transcatheter Occlusion Technique of Patent Ductus Arteriosus

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Introduction:
Ductus arteriosus is a muscular artery that provides the blood to pass from pulmonary artery to aorta in the fetal period. Persistent or patent ductus arteriosus (PDA) is called when ductus arteriosus is not closed or persists opened after birth.At newborn period it is provided to close PDA using prostaglandin synthetase inhibitor (indomethasine). Percutaneous endovascular occlusion technique can be applied to smaller PDA which could not closed in spite of medical treatment that is an alternative treatment to surgical approach. In our hospital, occlusion of PDA with percutaneous transcatheter technique was applied to 34 patients between January 1997 to March 2004. In two of them, surgical attempt was applied because of falling apparatus to pulmonary artery.

Case 1:
A 1 year old 76 cm male patient weighing 7080 g had a diagnosis of PDA. During the coil procedure to close PDA, the coil broke down from the system related with free part and the part of aortic side of coil caused serious hemolysis. The patient was taken to angiography laboratory to pull coil to pulmonary artery, but it was not taken out because of sliding the coil to the distal point of right pulmonary artery. The patient was taken to operating room from angiography laboratory immediately. Sternotomy was made. PDA was seen after the dissection of aorta and pulmonary artery. Double ligation and transfixation were applied to occlude the PDA. The placement of coil was established with the exploration of right pulmonary artery from proximal to distal side, at the end the coil was taken out from pulmonary artery by stitching this segment.

Case 2:
A 20 month old 84 cm male patient weighing 9870 g and with the diagnosis of PDA. During the coil procedure to occlude PDA, the coil slided to left pulmonary artery. He was taken to operating room because of failure to pull coil out in the angiography laboratory. Left

posterolateral thoracotomy was made. The placement of coil was established with the exploration of left main pulmonary artery from proximal to distal side and pulled out. Double ligation and transfixation were also applied to PDA.
In two cases, peripheric venous way was opened after sevoflurane induction. After endotracheal intubation, intra-arterial monitorization was made from radial artery and central venous pressure monitorization was made from internal jugular vein with 5F catheter. The anesthetic maintainence was provided with sevoflurane, fentanyl and cisatracurium.

Discussion and result:
In cases with small or medium sized PDA, percutaneous transcatheter endovasculary technique is a safety and effective method. But in cases which developed complications after percutaneous technique or required surgical interventions, early and appropriate approach can be life saving.

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A Case Report: A-V Fistula after Insertion of Central Venous Catheter

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The insertion site for central venous cannulation preferred by most anaesthesiologists is the right internal jugular vein (IJV), with success rates using this approach reported to be 88–95%. The complication most cited, inadvertent carotid artery puncture, occurs in approximately 5%. A-V fistula is a rare complication after insertion of central venous catheters. The incidence of arteriovenous fistula formation after large-bore catheter insertion into an artery is low, ranging from 0.01% to 0.6%.

Case Report:
A 25-year old man required intraoperative right IJV cannulation with a triple-lumen catheter for invasive monitoring and fluid optimization in the setting of combined renal and pancreatic transplantation. During line placement using a landmark technique, the anaesthetist had inadvertently punctured the right carotid artery and local pressure had been applied for 10 full minutes. The patient was successfully extubated at the end of the surgery and was transferred to the department of surgery. Six months after the operation, the surgeon noted a thrill on his neck at routine physical examination. Doppler ultrasonography reported a fistula between the right subclavian artery and right internal jugular vein. Further workup with bilateral carotid arteriography reported another fistula between the right vertebral artery and the right internal jugular vein. After a few months, the council of transplantation was given a decision to operate for fistula ligation. Preoperative assessment was very normal (Laboratory data, blood gas analysis, EKG and chest X-ray). After induction and intubation, basic vascular structures were dissected with right cervical incision by the surgeon. The fistula between the vertebral artery and a branch of the internal jugular vein was found to be at the entry of cranium. The fistulae were divided and ligated. At the conclusion of surgery, the patient was transferred to the intensive care unit still intubated, but was successfully extubated in there.

Discussion:
Arteriovenous fistulae may not involve immediate high risks but may lead to oedema or arterial insufficiency downstream of the involved region. Therefore we must recognize the anatomy of the structure on the neck (especially, vascular structures). In the hands of trained clinicians, insertion of central venous catheters is a safe procedure.

Total Airway Obstruction with Topical Anesthesia

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Introduction:
In cases involving patients with difficult airways, the gold standard technique for securing the airway is an awake fiberoptic intubation. However, topical anesthesia to the upper airway causes significant declines in respiratory function. This case illustrates the effect of topical anesthesia on a compromised airway, which led to complete airway obstruction.

Case Presentation:
A 70 year-old man with a history of squamous cell cancer in the base of the tongue, having undergone two prior surgeries that included glossectomy, pharyngectomy, laryngoplasty, myocutaneous flaps, radiation and chemotherapy, presented for resection of the second recurrence of the cancer. A previous tracheostomy had been closed many months earlier. A CT scan done two months prior to this admission demonstrated recurrence of the cancer in the mandibular area. The patient's mouth opening yielded a visible distance of approximately 1.5cm between the upper anterior teeth and the muscular flap at the floor of the mouth that was now indurated and rigid due to the tumor. He denied any difficulty breathing. An awake, fiberoptic orotracheal intubation was planned. The only premedication given was 0.2 mg of intravenous glycopyrrolate. Within one minute after the minimal administration of aerosolized 4% lidocaine to the oropharynx via a handheld atomizer, the patient complained of difficulty breathing. Suddenly, he was unable to speak, and the use of accessory respiratory muscles and suprasternal retractions were noted. Room air oxygen saturation fell from 97% to 83%. Complete airway obstruction was occurring. Positive pressure ventilation via facemask and jaw thrust were initiated and proved to be difficult. An emergent tracheostomy was performed. Positive pressure ventilation was maintained throughout the tracheostomy with resulting oxygen saturations of 89-93%. The tracheostomy required 18 minutes due to previous surgery and radiation therapy. Afterwards, another CT scan was performed, which showed marked expansion of the cancer compared to the scan done two months prior. The tumor now extended below the level of the hyoid and significantly compromised the patient's airway.

Discussion:
There are three studies in the literature that demonstrate the respiratory effects of anesthetizing the airway in healthy volunteers. They all showed statistically significant decreases in inspiratory flows, with peak inspiratory flows averaging around 1.5 L/min less than baseline. Based on flow patterns, most subjects developed partial obstruction at the level of the glottis during inspiration, with flows sometimes almost reaching zero. The learning points would be the following:
– If more recent imaging were available, an awake tracheostomy might have been planned.
– Patients with severe airway narrowing may not complain of difficulty breathing.
– The effects of topical anesthesia on a compromised airway led to total airway obstruction.
– Topical anesthesia to the upper airway has been shown to decrease inspiratory flows and cause an obstructive pattern during inspiration.

Complicated Airway Management in a Postoperative Patient with an Unstable Cervical Spine and a Difficult Airway

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Introduction:
The Laryngeal Mask Airway Classic™ (LMA North America Inc., San Diego, California, USA) has been the subject of many case reports and studies relating to its use in difficult airway situations, both as a primary and rescue airway device. It has become an important part of the ASA difficult airway algorithm (1). A competing device, the AuraOnce™ (Ambu Inc., Glen Burnie, Maryland, USA) released in 2005 is in increasingly common usage. It is unique because of a more acute angle in the device, a feature which some clinicians feel makes it more easily and more reliably positioned, especially in a difficult airway situation. To date there are no reports of fiberoptic intubation through the Ambu AuraOnce.

Case:
A 90 year old 56 kg woman underwent a posterior C1-C2 fusion for a dens fracture. Her history was significant for hypertension and a recent onset of bulbar pathology that did not carry a formal diagnosis. On examination she had a Mallampati class 4 airway with a 3 cm interincisor distance. To secure her airway for the procedure, the patient underwent awake fiberoptic intubation. Immediately following surgery, the patient's neck was set into a flexed posture by a large external brace. She was extubated in the operating room upon emergence from anesthesia. In the post-anesthesia care unit she suffered from respiratory distress secondary to upper airway obstruction. Attempts to reintubate the patient's trachea with the glidescope and fiberoptic bronchoscope were unsuccessful so a #3 Ambu® AuraOnce laryngeal mask was placed. Ventilation was successful via the Ambu device for a short time but the patient again demonstrated evidence of

upper airway obstruction with a decreased oxygen saturation. During this time, several endotracheal tubes were tested for ease of passage through an identical device; the largest that would fit was a 5.5 mm uncuffed tube and then only after lubrication was applied. The patient's trachea was then fiberoptically intubated through the Ambu laryngeal mask with a 5.5 mm uncuffed endotracheal tube.

Discussion:
The LMA Classic and the Ambu AuraOnce are similar devices with essentially similar functions and efficacy (2). However, their designs are different. The Ambu device, for instance, has a more acute angle in the device to facilitate easier placement. These differences necessitated the testing of different endotracheal tubes prior to attempting intubation. The result of this impromptu test was that although the LMA can accommodate a 6.0 mm cuffed ETT, the #3 size Ambu AuraOnce could not. It was deemed unsafe to remove that rescue device and attempt to replace it with an LMA. Further, the uncuffed tube yielded the largest tube lumen possible. Therefore, the 5.5 mm uncuffed tube was chosen, and even this down-sized tube required copious lubrication before it could pass through the laryngeal mask and into the patient's trachea.
Our patient had adequate ventilatory efforts and therefore our goal was to relieve an upper airway obstruction. An uncuffed tube accomplished this goal quite well. If the patient had required more ventilator support or large tidal volumes / higher inspiratory pressures, a cuffed tube would have been essential. If this had been the case, perhaps the best option would have been a long 5.0 mm cuffed ETT. Finally, following intubation the cuff of the AuraOnce was partially deflated in order to reduce pharyngeal pressure and avoid pressure-related pharyngeal or laryngeal injury (3). It is important to recognize this risk if any supraglottic airway device is to be left in place for an extended period.

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Intensive Insulin Therapy (IIT) for Tight Glycemic Control in Cerebral Ischemia: How Tight does it need to be?

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Aim of This Review:
Safety and efficacy of tight glycemic control with intensive insulin therapy in cerebral ischemia.

Introduction:
The Surgical Care Improvement Program (SCIP) aims to reduce the incidence of surgical complications by 25% by the year 2010. Tight perioperative glycemic control was advocated as one of the measures. Van Den Berghe in a landmark study showed that IIT reduces morbidity and mortality among critically ill patients (1). This study led to many ICUs practicing tight glycemic control using IIT. But how safe is it? And what levels of blood glucose are safe?

Evidence:
Relationship of Hyperglycemia and Worse Outcome Studies: Hyperglycemia following traumatic brain injury (TBI) worsens outcome (2). There is overwhelming evidence that supports the theory that acute hyperglycemia adversely affects stroke outcome. It can double the infarct size, reduce penumbral salvage and worsen functional outcome (3). In patients who have suffered from subarachnoid hemorrhage (SAH), hyperglycemia has been identified as an independent predictor of outcome (disability or death). Hyperglycemia is associated with the development of symptomatic vasospasm after SAH. In animal studies, hyperglycemia has been reported to aggravate spinal cord injury.

Conclusion:
Hyperglycemia has been associated with poor outcome in critically ill patients. Hence tight glycemic control is practiced in many ICUs. However, an ischemic brain shows low cerebral glucose levels with evidence of cellular distress worse with hypoglycemia. Overzealous reduction of plasma glucose by way of intensive insulin therapy may be self defeating. Greater caution is needed with frequent monitoring of blood glucose. If resources permit, monitoring of cerebral glucose by microdialysis catheter, which is more meaningful, may be considered.

Evidence: Intensive Insulin Therapy (IIT). What Level of Blood Glucose (BG) is Safe?

Author	Title	Trial	n	Measurement	Diagnosis	Conclusions
Bilotta et al. (2008)[4]	Intensive insulin therapy after severe TBI	Prospective RCT	97	IIT range 80-120 mg/dl Conventional Insulin therapy started when BG>220 mg/dl	TBI	ICU stay shorter in IIT. IIT significantly associated with risks of hypoglycemic episodes. IIT has no significant benefits on long term neurological outcome
Schlenk et al. (2008)[5]	Hyperglycemia and cerebral glucose in aneurysmal SAH	Prospective RCT	28	Microdialysis catheter	SAH	Low cerebral glucose was associated with severe metabolic distress (↑lactate/pyruvate ratio, ↑glutamate and glycerol)
Vespa et al. (2006)[6]	IIT reduces microdialysis glucose values without altering glucose utilization or improving lactate/pyruvate ratio after TBI	Prospective Monitoring followed by retrospective data analysis non RCT	47	IIT 14 pts had 70% reduction in blood glucose Conventional Group 15% reduction in blood glucose	TBI	IIT results in a net reduction in micro dialysis glucose and increase in microdialysis glutamate, lactate/pyruvate ratio without an advantage in functional outcome

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Compartment Syndrome following Heparin and TPA for Middle Cerebral Artery Thrombosis

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Introduction:
Bleeding complications following anticoagulation and thrombolysis in acute ischemic stroke are well documented. Rare among these, however, is the occurrence of compartment syndrome. We present a case of compartment syndrome following the use of ASA, heparin and tPA for middle cerebral artery thrombosis.

Case Report:
A 59 year old male with a history of untreated hypertension and hyperlipidemia presented with sudden onset of dizziness followed by slurred speech and weakness of the left face, arm and leg. An initial head CT was normal, ruling out hemorrhagic stroke. Brain MRI revealed an area of acute ischemic change in the distribution of the right lenticulostriate artery. Brain MRA revealed high grade stenosis involving the distal portion of the M1 segment of the right MCA and reduced caliber of major branch vessels distal to the stenosis. The patient was then started on a heparin drip. On hospital day 2, a cerebral angiogram was performed and revealed a thrombus in the M1 segment of the right MCA. During the procedure, the patient again developed left arm weakness. A phenylephrine drip was started to maintain SBP >140 and the symptoms subsequently resolved. The patient then underwent intra-arterial tPA therapy and angioplasty of the M1 segment of the right MCA. The procedure was tolerated

well and the patient was subsequently transferred to the ICU where his neurological exam remained unchanged. The phenylephrine drip was continued to maintain SBP >140mmHg. The patient was started on Lipitor and continued on ASA and a heparin drip, with a target aPTT of 60-80. Laboratory data on hospital day 2 included aPTT values of 140, 96 and 66. Hematocrit was 42.2%. Overnight, the patient developed progressively worsening left hip pain and by the morning of hospital day 3 had developed paresthesias in his left toes. Physical exam revealed a markedly edematous left thigh as well as a large posterior thigh ecchymosis. He was again noted to have decreased left side strength (3/5). A total of 6L of crystalloid had been infused overnight and the hematocrit had fallen to 28.7% on the morning of hospital day 3. Packed red blood cells were transfused and orthopedics consult was obtained. A diagnosis of compartment syndrome was made and the patient was taken emergently to the operating room for left thigh fasciotomy and evacuation of hematoma.

Discussion:
The most important therapy in the management of acute ischemic stroke is restoration of blood flow to the ischemic area and penumbra (1). Intravenous thrombolytic therapy with TPA has been in use since its approval in 1996. Intra-arterial thrombolysis at the site of occlusion is an experimental treatment that may offer an expanded time window for treatment (2). Anticoagulation is of unproven benefit in the management of acute ischemic stroke. Many potential bleeding complications following thrombolysis are well documented. To our knowledge, however, this is only the second case report documenting compartment syndrome following thrombolytic therapy (3). The bleeding, and subsequent fall in hematocrit from 42.2 to 28.7, may have further compromised oxygen delivery to the ischemic penumbra. A heightened awareness of the potential for occult bleeding, and possible compartment syndrome, is warranted in ischemic stroke patients known to have fallen who are receiving anticoagulation and TPA.

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Comparison of Intraoperative Earlobe and Forehead Pulse Oximetry Monitoring in Vascular Surgery Patients

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Introduction:
Sensors for measuring peripheral oxygen saturation (SpO2) are typically placed on a finger, and are dependent on pulsatile flow. Continuous SpO2 monitoring may be compromised, however, in patients with peripheral vascular disease secondary to poor perfusion. SpO2 can now be measured from a reflectance sensor placed on the forehead, where superficial blood flow is high (1). This new sensor may be more effective than traditional sensors in patients with poor peripheral perfusion since the forehead is resistant to adrenergic responses (2). We compared the forehead and ear (reportedly more reliable than the finger [3]) sites for SpO2 monitoring, to evaluate their performance in vascular surgery patients.

Methods:
Following IRB approval, the Nellcor MAX-fast forehead probe and a Masimo SET earlobe probe were used to simultaneously and continuously monitor SpO2 following induction of anesthesia in patients undergoing vascular surgery. Patients remained supine, and their anesthetic care was left to the discretion of the anesthesiologist. Arterial blood gases (ABG) were measured as clinically indicated. Data from the two sites was compared using Bland-Altman analysis.

Results:
Time paired SpO2 data from both probes was collected from 20 patients for a total of 3,992 data pairs, with SpO2 ranging from 85% to 100%. Neither probe site failed to display SpO2 for more than 1 minute. All SaO2s obtained from the ABGs were >97%, which closely matched the corresponding SpO2s. A Bland-Altman analysis of the two sites showed a bias of 0.7% and limits of agreement of –2.6% to +4.0% (95% of data falling within this range). Figure 1 shows the Bland-Altman plot. Figure 2 suggests that the forehead

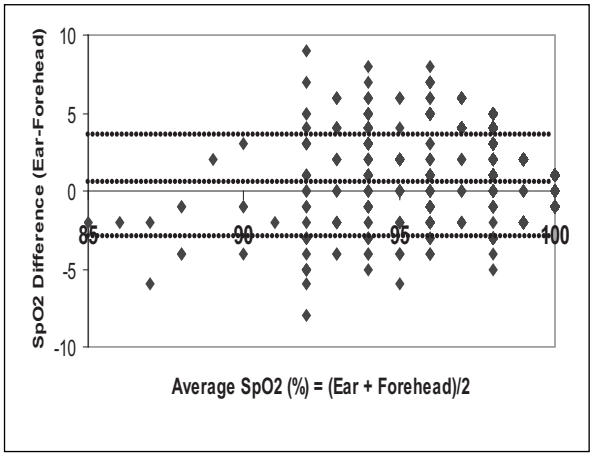

Figure 1

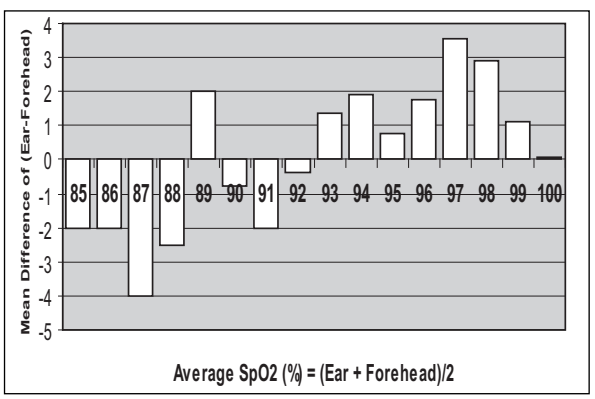

Figure 2

site tended to yield higher values at lower (<93%) SpO2, while the ear tended to display higher readings at higher (>92%) SpO2.

Discussion:
There is clinically acceptable concordance, and low observed sensor failure rates of the ear and forehead SpO2 sites in patients undergoing vascular surgery. Our study was limited by a small number of low SpO2 values, and a lack of correlation with true SaO2 data from ABGs (since samples were not always available during mild transient hypoxemic episodes). Additional studies are needed to further delineate the discrepancies between the two monitors at lower SpO2. Correlation with ABG at such times may be beneficial in determining which monitor performs better in vascular patients with poor perfusion.

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Hepatic Metastasectomy for Soft-tissue Sarcomas

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Background:
Except for patients with gastrointestinal stromal tumors (GIST), systemic chemotherapy in patients with liver metastasis of soft-tissue sarcoma (STS) is not effective. Therefore, all patients with resectable liver metastases underwent surgical therapy. We present our experience with this approach during the last 13 years.

Methods:
All patients (n = 45) with liver metastasis of STS undergoing surgical therapy were prospectively analyzed. Clinical and histopathological parameters as well as the postoperative course were recorded. Survival data were analyzed by using the Kaplan-Meier method and the log-rank test.

Results:
Twenty-seven of 45 patients with liver metastasis underwent hepatic resection; 59% of these patients had a solitary metastasis, 22% had two metastases, and 18% had three or more metastatic nodules. The surgical perioperative mortality was 7%. The median survival was 44 (range, 1–123) months, and the 5-year survival was 49%. Repeated resection for recurrent tumor was performed in eight patients, which yielded a median survival of 76 months.

Conclusions:
Patients who have hepatic metastases that are functionally and technically resectable should be considered for surgery because this treatment offers the chance for long-term survival (5 years).

Cystatin C – A Fast and Reliable Marker to Predict Glomerular Filtration Rate in Renal Disease

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Background/Aim:
Knowledge of the usefulness of cystatin C measurement in the detection of chronic kidney disease in patients with head and neck cancer (HNC) is scant. The purpose of this study was to evaluate the ability of plasma cystatin C- and creatinine-based methods to predict glomerular filtration rate (GFR) and classify chronic kidney disease in HNC patients.

Methods:
The study population consisted of 43 HNC patients aged 39-76 years. Comparisons were made between measured plasma creatinine, cystatin C, creatinine clearance and GFR estimated by the Modification of Diet in Renal Disease (MDRD) formula. The plasma clearance of (51)Cr-EDTA served as a reference method.

Results:
The Pearson correlation coefficients between plasma clearance of (51)Cr-EDTA and the markers of GFR were calculated. The correlation coefficients were 0.765 for cystatin C, 0.688 for plasma creatinine, 0.585 for GFR values estimated by MDRD and 0.568 for plasma creatinine clearance.

Conclusion:
We recommend using Cystatin C for the estimation of the GFR of HNC patients instead of solely creatinine or creatinine clearance in clinical practice.

Three-dimensional Echocardiography: A Useful Tool in the Diagnosis of an Unroofed Coronary Sinus

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Introduction:
An Unroofed Coronary Sinus (URCSS) is a rare cardiac anomaly in which a communication occurs between the coronary sinus and the left atrium as a result of partial or complete absence of the roof of the coronary sinus. In the case we present, unroofing is noted in the mid to terminal portion of the coronary sinus. This entity is frequently associated with a persistent left superior vena cava. The diagnosis of this lesion is important due to the clinical consequences, such as right-to-left intracardiac shunting resulting in cyanosis and polycythemia, as well as representing a potential source for cerebral emboli (1,2).
We describe the case of an adult patient in which real-time three-dimensional transesophageal echocardiography (RT-3D TEE) proved useful in the assessment of this anomaly.

Case Presentation:
A 54-year old asymptomatic male with no significant medical history received a cardiac work-up after a heart murmur was incidentally discovered during a routine orthopedic procedure. A transthoracic echocardiogram showed severe mitral regurgitation in the setting of normal left ventricular function (LVEF 58%). A computed tomographic coronary angiography (CTCA) revealed normal coronary arteries, but also the unexpected finding of all cardiac veins draining directly into the left atrium.
The intraoperative transesophageal echocardiogram (TEE) confirmed the diagnosis of severe MR. Additionally a jet was seen in the left atrium, originating from the postero-medial region of the left atrial wall. (Image) To gain better understanding of the topographic anatomy of this region RT 3D TEE was utilized showing a clear picture of an unroofed coronary sinus. (Image). By spatially reorientating the data set we were able to examine the ostium of the coronary sinus viewed from the right atrium. The ostium was small and septated. As a consequence of these findings the heart was arrested and protected, while on cardiopulmonary bypass (CPB), utilizing only antegrade cardioplegia. The presence of an URCS and persistent left superior vena cava was confirmed. The mitral valve

was successfully repaired and the patient weaned of CPB without difficulty. The post-operative course was uneventful.

Discussion:
URCSS represented an unknown pathology to cardiac pathologists prior to the era of cardiac catheterization and cardiac surgery. Generally the surgeon viewing external and internal morphology of the heart while on CPB makes the diagnosis.
Cyanosis from right-to-left shunt dominates the clinical picture of URCSS and determines its natural history. Cerebral embolization resulting in transient ischemic attacks or stroke and brain abscess complicates the natural history in 10 to 25% of patients. Presumably, life expectancy is considerably reduced by this complication and by other problems associated with increasing cyanosis and polycythemia. When diagnosis of isolated URCSS is made a corrective operation is advisable because of arterial desaturation, risk of cerebral emboli and low perioperative morbidity and mortality (3).
With the aid of 3D TEE we were able to obtain an image that was pathognomonic for this congenital anomaly.

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Is an Increase in Lactate Concentration Associated with Cardiac Dysfunction after cardiopulmonary bypass?

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Blood lactate concentration has proven to be one of several reliable parameters for evaluating hemodynamic state in post-cardiac-surgery patients. In general, low output syndrome leads to poor peripheral circulation and high lactate concentration. After cardiac surgery, high lactate concentration is associated with high morbidity and mortality.
Even so, the relationship between blood lactate concentration and cardiac output has not been thoroughly investigated in cardiac disease patients.
Postoperative changes in lactate concentration have not been reported in detail. Hyperlactatemia during cardiopulmonary bypass is relatively frequent and is associated with an increased postoperative morbidity.
The aim of this study was to determine which perfusion-related factors may be responsible for hyperlactatemia, and specifically to verify the clinical impact of hyperlactatemia during cardiopulmonary bypass in terms of postoperative morbidity and mortality rate.

Safe Extubation of a Patient While Receiving Inhaled Epoprostenol after Implantation of Ventricular Assist Device

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Pulmonary artery hypertension (PAH) is a life threatening condition that is potentially associated with right ventricular failure. After placement of a left Ventricular Assist Device (LVAD) it is imperative to control pulmonary arterial pressures, as the right ventricle benefits from afterload reduction in the pulmonary circulation. Since intravenous pulmonary vasodilators lack selectivity and are associated with systemic hypotension as well as ventilation-perfusion mismatch, it may be preferential to use inhaled pulmonary vasodilators in the perioperative period. In the case of epoprostenol, this requires the patient to remain intubated to receive a constant nebulization of the medication. Abrupt withdrawal of this medication may lead to rebound pulmonary hypertension and subsequent right ventricular failure.
We present a first described case of a 51year old male who was safely extubated while on inhaled nebulized epoprostenol. This occurred after implantation of a LVAD (Jarvik-2000) for severe bi-ventricular heart failure from a myocardial infarction. Safe extubation without rebound pulmonary hypertension was accomplished by continuing to provide the epoprostenol continuously through a small volume nebulizer with O_2 face-mask after extubation. During this post-extuba-

tion period, the medication was decreased in a stepwise fashion from 12.5 ng/kg/min to 0 ng/kg/min over four hours with no change in pulmonary arterial pressure, cardiac index, mixed-venous blood gas or PaO_2.

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